Multipoint Data Recorder
PM8238

Operation Manual

4822 872 70353
880301

PHILIPS

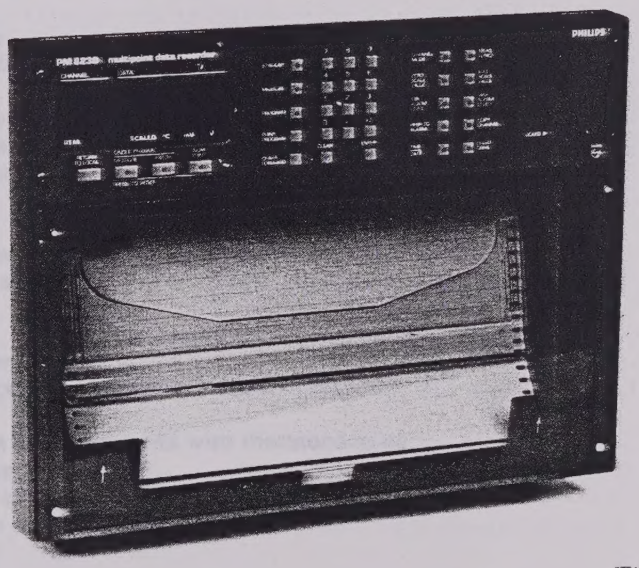
Industrial &
Electro-acoustic Systems

PHILIPS

Multipoint Data Recorder
PM8238

Operation Manual

4822 872 70353
880301



ST5405

PHILIPS

PHILIPS

IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

Note: *The design of this instrument is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.*

© N.V. PHILIPS GLOEILAMPENFABRIEKEN-EINDHOVEN-THE NETHERLANDS-1988

Printed in the Netherlands

CONTENTS

Page

1. **SAFETY** 1-1E

2. **CHARACTERISTICS** 2-1E

2.1. FUNCTIONAL DESCRIPTION 2-1E
2.1.1. Input channels 2-1E
2.1.2. Operating modes 2-1E
2.1.3. Measurements possible 2-1E
2.1.4. Representation of data 2-2E
2.1.5. Chart drive 2-2E
2.1.6. Protection of the recorder settings 2-2E
2.1.7. Clock-calendar circuit 2-2E
2.1.8. Alarm setpoints 2-3E
2.1.9. Principle of operation 2-3E

2.2. TECHNICAL SPECIFICATION 2-3E
2.2.1. General 2-3E
2.2.1.1. Power supply 2-3E
2.2.1.2. Electromagnetic compatibility 2-4E
2.2.1.3. Safety 2-4E
2.2.1.4. Dimensions and weight 2-4E
2.2.1.5. Environmental conditions 2-4E
2.2.1.6. Reference conditions 2-4E
2.2.1.7. Resolution 2-5E

2.2.2. Voltage measurements 2-5E
2.2.2.1. Ranges and span 2-5E
2.2.2.2. Accuracy 2-5E
2.2.2.3. Input 2-6E
2.2.2.4. Measuring time 2-6E
2.2.2.5. Scaled voltage measurements 2-6E

2.2.3. Temperature measurements with thermocouples 2-6E
2.2.3.1. Thermocouple types 2-6E
2.2.3.2. Ranges and span 2-6E
2.2.3.3. Cold junction compensation 2-7E
2.2.3.4. Linearisation 2-7E
2.2.3.5. Accuracy 2-7E
2.2.3.6. Input 2-8E
2.2.3.7. Measuring time 2-8E

2.2.4. PT 100 temperature measurements 2-8E
2.2.4.1. Measuring principle 2-8E
2.2.4.2. Ranges and span 2-8E
2.2.4.3. Accuracy 2-9E
2.2.4.4. Linearisation 2-9E
2.2.4.5. Input 2-9E
2.2.4.6. Measuring time 2-9E

2.2.5. Measurement of resistance transducers 2-9E

2.2.6. Differential measurements 2-9E
2.2.6.1. Measuring function 2-9E
2.2.6.2. Accuracy 2-10E

Page

2.3. ACCESSORIES ... 2-11E

2.4. OPTIONS ... 2-11E
2.4.1. Survey and ordering information ... 2-11E
2.4.2. A set of 3 program modules ... 2-12E
2.4.3. Interfaces to other devices ... 2-12E
2.4.3.1. IEC625/IEEE488 and RS232C/V24 interface 2-12E
2.4.3.2. Extended control interface ... 2-12E
2.4.4. Alarm option ... 2-13E
2.4.5. Thermocouple linearisation units ... 2-14E
2.4.6. 19" rack mounting set ... 2-14E

2.5. RECORDING PAPER ... 2-14E

3. PREPARATIONS FOR USE 3-1E

3.1. INSTALLATION ... 3-1E
3.1.1. Initial inspection ... 3-1E
3.1.2. Transit securities ... 3-1E
3.1.3. Mounting the paper collection tray ... 3-1E
3.1.4. Loading the chart ... 3-2E
3.1.5. Inserting the program module ... 3-3E

3.2. MAINS SUPPLY ... 3-3E
3.2.1. Safety instructions ... 3-3E
3.2.2. Earthing ... 3-3E
3.2.3. Connecting the recorder to the mains ... 3-4E
3.2.4. Replacing the mains fuse ... 3-4E
3.2.5. Adaptation to the local mains voltage and frequency ... 3-4E

3.3. REPLACING THE PROGRAM MODULE BATTERY ... 3-4E

4. CONNECTING THE TRANSDUCERS, ALARM OUTPUT 4-1E

4.1. INPUT TERMINALS ... 4-1E

4.2. SIGNAL LEADS ... 4-1E

4.3. 2-TERMINAL OR 4-TERMINAL CHANNELS ... 4-1E

4.4. VOLTAGE MEASUREMENTS (mV, V) ... 4-2E

4.5. TEMPERATURE MEASUREMENTS WITH THERMOCOUPLES ... 4-2E

4.6 PT 100 TEMPERATURE MEASUREMENTS ... 4-3E

4.7. MEASUREMENT OF RESISTANCE TRANSDUCERS ... 4-4E

4.8. ALARM OUTPUT ... 4-5E

5. MANUAL OPERATION (LOCAL) 5-1E

5.1. SWITCHING ON ... 5-1E

5.2. PROGRAM MODULE ... 5-1E
5.2.1. Description ... 5-1E
5.2.2. Write protection ... 5-1E
5.2.3. Programming the recorder via the program module ... 5-2E
5.2.4. Copying program modules ... 5-2E

Page

5.3. THERMOCOUPLE BREAK DETECTION ... 5-2E

5.4. FRONT PANEL CONTROLS ... 5-2E
5.4.1. Operating keys ... 5-3E
5.4.2. Instrument parameter keys ... 5-4E
5.4.3. Channel parameter keys ... 5-5E
5.4.4. Numeric keys ... 5-6E

5.5. PROGRAMMING INSTRUCTIONS ... 5-7E
5.5.1. Setting the channel parameters ... 5-7E
5.5.1.1. Procedure ... 5-7E
5.5.1.2. Channel mode ... 5-8E
5.5.1.3. Measuring function: °C, mV, V, scaled, differential ... 5-9E
5.5.1.4. Zero- and full scale value, scaling ... 5-11E
5.5.1.5. Alarm levels ... 5-16E
5.5.1.6. Response to alarm ... 5-16E
5.5.1.7. Copy channel ... 5-17E

5.5.2. Setting the instrument parameters ... 5-17E
5.5.2.1. Time and date ... 5-17E
5.5.2.2. Chart speed, print interval time ... 5-18E

5.6. MEASURING, DISPLAYING AND RECORDING ... 5-19E
5.6.1. Measuring and displaying ... 5-19E
5.6.1.1. Measuring and displaying all channels ... 5-19E
5.6.1.2. Measuring and displaying one channel ... 5-19E
5.6.1.3. Measuring all channels, dipslaying one channel ... 5-19E

5.6.2. Recording ... 5-20E
5.6.2.1. Dot print mode ... 5-20E
5.6.2.2. Numeric print mode ... 5-21E
5.6.2.3. Combined dot + numeric print mode ... 5-22E

5.7. PRINTING THE CHANNEL SETTINGS ... 5-23E

5.8. PRINTING ADDITIONAL NUMERIC TEXT ... 5-24E

5.9. SELECTING A CHANNEL ... 5-24E
5.9.1. Selecting a channel to be programmed ... 5-24E
5.9.2. Selecting a channel to be measured and displayed ... 5-25E

6. ERROR MESSAGES 6-1E

1. SAFETY

Read this page carefully before installation and use of the instrument. This instrument meets the safety requirements of IEC 348 class 1.

INTRODUCTION

The instrument described in this manual is designed to be used by properly-trained personnel only.
Adjustment, maintenance and repair of the exposed equipment shall be carried out only by qualified personnel, who are aware of the hazards involved.

SAFETY PRECAUTIONS

For the correct and safe use of this instrument it is essential that both operating and servicing personnel follow generally-accepted safety procedures in addition to the safety precautions specified in this manual.
Specific warning and caution statements, where they apply, will be found throughout the manual.
Where necessary, the warning and caution statements and/or symbols are marked on the apparatus.

CAUTION AND WARNING STATEMENTS

CAUTION: *is used to indicate correct operating or maintenance procedures in order to prevent damage to or destruction of the equipment or other property.*

WARNING: calls attention to a potential danger that requires correct procedures or practices in order to prevent personal injury.

SYMBOLS

: To preserve the instrument from damage the operator must refer to an explanation in the instruction manual.

IMPAIRED SAFETY-PROTECTION

Whenever it is likely that safe operation is impaired, the instrument must be made inoperative and secured against any unintended operation. The appropriate servicing authority must then be informed. The safety protection is likely to be impaired if, for example, the instrument fails to perform the intended measurements or shows visible damage.

2. CHARACTERISTICS

2.1 FUNCTIONAL DESCRIPTION

2.1.1 Input channels

The recorder is provided with 30 rows of 2 input terminals each. By using 2-terminal input channels a maximum of 30 channels can be obtained.
By using 2 rows of 2 terminals, a 4-terminal input channel is obtained.

2.1.2 Operating modes

The recorder has three basic operating modes viz:

- STANDBY mode
- MEASURE mode
- PROGRAM mode

STANDBY mode

Measuring, recording and programming are disabled. By means of the numeric keyboard it is possible to print numeric text on the chart.

MEASURE mode

In the measure mode the instrument is measuring, displaying and recording.
If required, one channel only can be measured and recorded or the measuring result of one channel only can be displayed.

PROGRAM mode

In the program mode all channel dependent parameters can be verified and set.

2.1.3 Measurements possible

Measurement quantities

The recorder can measure voltages, temperatures (with the aid of thermocouples or PT100 resistance thermometers) and the resistance of transducers (by means of an internal current source). For thermocouple temperature measurements, a choice can be made between internal (automatic) and external cold-junction compensation. For internal compensation the input terminal connection at the input block is the cold-junction. External cold-junction compensation is possible at fixed temperatures of 0°C, 20°C or 50°C or with a temperature measured in any other channel.
A break in a thermocouple can be detected and indicated.

Differential measurements

The difference between the input values of two channels can be recorded.

Scaled measurements

Scaling of the measured value is possible for voltage measurements. The measurement result X is adapted according to the formula AX + B. The calculated result is represented by the recorder.

2.1.4 Representation of data

On the chart

By selection, measured values can be recorded on the chart in two ways:

- as dotted lines.
  Per channel zero dots (no printing), one dot (normal line) or a special marking per printed measurement result can be selected.
  Interpolated printing is also possible.
- as numerals in tables.
- as a combination of dotted lines and numeric tables.

The following data can be printed on the chart:

- Time and date
- Channel number of the measured channel
- Chart speed, print interval time and divisor for externally supplied chart feed pulses. The latter only if an EXTENDED CONTROL option PM9893/01 is installed.
- Minimum and maximum alarm indication
- Measurement error indication e.g. thermocouple break
- The channel settings
- Numeric text; in the STANDBY mode additional numeric text can be printed via the numeric keyboard.

On the display

The measured value is displayed with the appropriate channel number. The programmed parameters can be displayed with the appropriate channel numbers.

Via an interface (optional)

Via one of the optionally available IEEE 488/IEC 625 or RS232C/V24 interfaces the measurement results and the recorder settings can be output. Control of the instrument is also possible.

2.1.5 Chart drive

The chart can be driven in the following ways:

in the dot print mode

- with a selected chart speed (max. 60 mm/min.)
- by supplying pulses via the EXTENDED CONTROL option PM9893/01

in the numeric print mode

- every print scan cycle the chart is transported over a distance of 14 mm (6 mm at single channel measure).

in the standby mode

- one line feed of 5 mm is performed when the ENTER key is pressed.

in the program, measure and standby mode

- pressing the CHART FORWARD pushbutton transports the chart in the forward direction.

2.1.6 Protection of the recorder settings.

The recorder settings are stored in a program module. Its supply voltage is maintained by a battery.
For protection against undesired operation and/or programming a switch is provided to disable the keyboard.

2.1.7 Clock-calendar circuit

The built-in clock - calendar circuit is battery powered and provides time and date.

2.1.8 Alarm setpoints

Minimum- and maximum alarm levels can be set per channel. When an alarm level is exceeded the recorder can react in one or more of the following ways:

- Start recording the relevant channel with a special marking (in dot mode).
- Print a > or a < sign (in numeric mode) for a maximum- or minimum alarm after the measurement result.
- Increase the chart speed by a factor 10; only for selected chart speeds <60 mm/hr.

  NOTE: for chart control via the PM9893/01 EXTENDED CONTROL option only if the dividing factor >20.
- Activate the alarm switches at the rear or on the alarm option PM9895/02.

2.1.9 Principle of operation

General

The instrument is microprocessor controlled. Its program is stored in a read only memory. The settings are stored in a battery powered program module.

Measuring

During one measurement scan of the selected channels, the input signals are sampled once, i.e. the input signals are connected to the ADC input by means of relays. The ADC converts the analog input signals into digital codes.

Recording

After one (or more) measurement scans, the measurement results are recorded during a print scan.
The results are recorded graphically (dot print mode) or printed out in tabular form (numeric print mode). The position of the print head is controlled by a stepping motor. One step corresponds to a print head displacement of 0.25 mm; 1000 steps correspond to full scale deflection.
The thermal print head is provided with seven heating elements. When an element is switched on, a dot is printed on the thermosensitive chart. The characters are built-up in a 5 × 7 dot matrix.
The chart is driven by a stepping motor. Each step corresponds to a chart movement of 0.05 mm.

2.2 TECHNICAL SPECIFICATION

- This instrument has been designed and tested in accordance with IEC Publication 348 for Class 1 instruments and has been supplied in a safe condition. The present Operating Manual contains information and warnings which shall be followed by the purchaser to ensure safe operation and to retain the instrument in a safe condition.
- Properties expressed in numeric values with stated tolerance are guaranteed by PHILIPS. Specified non-tolerance numeric values indicate those that could be nominally expected from the mean of a range of identical instruments.
- This specification is valid after the instrument has warmed up for 30 minutes (reference temperature 23°C ±2°C)

2.2.1 General

2.2.1.1 Power supply

Mains voltage (factory set)	220-240 Vac ±10 % 110-127 Vac ±10 %
Distortion	±5 % on wave form (B = 0.05)
Mains frequency	50 Hz ±5 % (can be set to 60 Hz)
Fuse	1,6 A-T (slow blow) for all mains voltages.
Power consumption	100 VA

2.2.1.2 Electromagnetic compatibility (EMC)

Acc. to	IEC 555 part 3 IEC 801 parts 2, 3, 4, 5 Mil. Std. 462; RS01-CS01, CS02 VDE 0871 + Vfg. 1046, Class B

2.2.1.3 Safety

Electrical safety	acc. to IEC 348 class I VDE 411 class I

2.2.1.4 Dimensions and weight

Dimensions	heigth 284 mm (feet included) width 352 mm depth 444 mm
Weight	13 kg approx.

2.2.1.5 Environmental conditions

Climatic condions	acc. to IEC 359, C1* tested acc. to IEC 68
- Rated temperature (instrument complies with spec.)	+5...+50°C
- Limit temperature of use	−10...+50°C
- Humidity	20...80% R.H. non-condensing max. dew point temperature is 26°C
- Barometric pressure	70...106 kN/m²
- Air velocity	0...0.5 m/s
Mechanical conditions	acc. to IEC 359, M2* tested acc. to IEC 68 Vibration 5 Hz/0.1 mm...60 Hz/0.01 mm Bump 2.5 m/s²/60 ms...10m/s²/10 ms
Storage and transport	acc. to IEC 359
- Temperature	−40...+70°C
- Humidity	5...95% RH
- Barometric pressure	53.3...106 kN/m²
- Vibrations	Frequency <150 Hz Acceleration <50 m/s² Bump 100 m/s²/6 ms

* Definitions

C1 (indoor)	Environment normally found in locations destined for human work. At least some degree of heating, but no air conditioning. Located maximum at 2200 m altitude.
M2 (vibrating structures)	- Equipment used in locations with a perceptable vibration level as found in e.g. factories, workshops etc. - Equipment subjected to normal handling during operation.

2.2.1.6 Reference conditions

Climatic conditions	acc. to IEC 359
- Temperature	23°C ±2°C
- Humidity	45..75% RH
- Barometric pressure	101.3 ±5.3 kN/m²
Supply conditions	rated range of use unless otherwise stated
Warm-up time	30 min.

2.2.1.7 Resolution

Recording in dot mode: 0.1% of the span (1000 points)

Recording in numeric mode and displayed value: Absolute value of the measured input signal is printed in four figures, see table below.

MEAS. FUNCTION	RANGE	NUM. PRINT OUT AND DISPLAY
mV	30 300 3000	X X.X X X X X.X X X X X
V	30	X X.X X
°C - PT100	–	X X X.X
°C - t.c. J, L	LOW HIGH	X X X.X X X X X
°C - t.c. K	LOW HIGH	X X X.X X X X X
°C - t.c. S	–	X X X X
°C - t.c. T, U	–	X X X.X

2.2.2 Voltage measurements

2.2.2.1 Ranges and span

The table below shows:
- The allowed span within the stated full- and zero scale values.
- the range in which the measurement is performed.

Function	Permitted span	Full and zero scale limits	Range
mV	1...30 mV	−30 ... +30 mV	30 mV
	5...300 mV	−300 ... −30 mV +30 ... +300 mV	300 mV
	50...3000 mV	−3000 ... −300 mV +300 ... +3000 mV	3000 mV
V	0.5...30 V	−30 ... +30 V	30 V

Example:

A 20 mV span is measured in the 30 mV range if the ZSV and FSV are both between −30 and +30 mV. When the FSV or ZSV (or both) are between −300 and −30 mV or +30 and +300 mV, the 300 mV range is automatically selected.

Span: The span is the difference between the selected zero scale value ZSV and the selected full scale value FSV

2.2.2.2 Accuracy

Accuracy: ±0.1% of the input value ±0.1% of the span

Temperature coefficient of accuracy: 0.02% of the input value per °C

2.2.2.3 Input

Input offset voltage	$<5\ \mu V$
Input offset voltage drift	$<0.5\ \mu V/°C$
Input current	<100 pA
Input impedance	10 MΩ
Maximum voltage between any input terminal and earth or between input terminals for safe operation	42 Vdc or 30 Vac
Possible input configurations	2- and 4-terminal
Common mode rejection ratio (CMMR)	>132 dB for dc
Series mode rejection ratio (SMRR)	>38 dB for 50 Hz ± 1%

Maximum series mode voltage to meet the specifications

Range	Max. SM voltage (Vac rms)
30 V	30 V - FSV
3000 mV	3000 mV - FSV
300 mV	300 mV - FSV
30 mV	30 mV - FSV

NOTE: The maximum input voltage is 30 Vac.

2.2.2.4 Measurement time

Time to measure 1 channel	100 ms

2.2.2.5 Scaled voltage measurements

Scaling	−9000... +9000
Specifications	as for voltage measurements

2.2.3 Temperature measurements with thermocouples

2.2.3.1 Thermocouple types

Thermocouple types

J-type, (Fe-Const)
L-type, (Fe-Const ; DIN)
K-type, (Chromel-Alumel)
S-type, (Pt-Rh 10Pt)
T-type, (Cu-Const)
U-type, (Cu-Const ; DIN)

2.2.3.2 Ranges and span

Type	Permitted span °C	Full and zero scale limits °C	Range °C	Min. input temp. (°C) for full resolution
J, L	25 ... 700	−200 ... + 500	LOW	−50
	250 ... 850	−100 ... + 750	HIGH	−20
K	30 ... 900	−200 ... + 700	LOW	−50
	300 ... 1470	−100 ... +1370	HIGH	−20
S	250 ... 1600	0 ... +1600	–	0
T, U	35 ... 600	−200 ... + 400	–	−50

The span is the difference between the full scale value FSV and the zero scale value ZSV.

NOTE: Some thermocouples offer a restricted resolution for low input temperatures. The input temperature above which full resolution (1000 points) is obtained at the minimum span is indicated in the table above. The table below shows, for two input temperatures, the minimum span to be selected to obtain full resolution.

Type	Range °C	T in °C	Min. span for full resolution °C	T in °C	Min. span for full resolution °C
J, L	LOW HIGH	– 200 – 100	54 300	– 100 – 50	29 263
K	LOW HIGH	– 200 – 100	71 376	– 100 – 50	36 321
T, U	–	– 200	116	– 100	41

2.3.3.3 Cold-junction compensation

Measured:

- internal (automatic)
  the cold-junction is the input terminal connection
- external
  the cold-junction temperature is measured in any other channel NN

Fixed:

- at 0°C, 20°C or 50°C

2.2.3.4 Linearisation

J, K, S and T type — acc. to IEC 584-1 (IPTS-68)
L and U type — acc. to DIN 43710

2.2.3.5 Accuracy (thermocouple excluded)

ACCURACY = BASIC ACCURACY + COLD JUNCTION CONTRIBUTION ±0.1% OF SPAN

BASIC ACCURACY (over rated temp. range)

Type	Range	Basic accuracy
J, L	LOW HIGH	±0.1% Tin ±0.2°C (or ±0.55°C if Tin < – 50°C) ±0.1% Tin ±0.4°C
K	LOW HIGH	±0.05% Tin ±0.35°C (or ±0.75°C if Tin < – 50°C) ±0.1% Tin ±0.8°C
S	–	±0.1% Tin ±1.3°C
T, U	–	±0.1% Tin ±0.3°C (or ±0.6°C if Tin < – 50°C)

COLD JUNCTION CONTRIBUTION = FACTOR F x COLD JUNCTION ACCURACY

(cold-junction temperature between 0°C and +50°C)

- **FACTOR F** (see table)

Type	Range	F
J, L	LOW HIGH	1.13 (or 2.42 if Tin < −50°C) 1.2
K	LOW HIGH	1.15 (or 2.7 if Tin < −50°C) 1.2
S	–	1.2
T, U	–	1.26 (or 2.72 if Tin < −50°C)

- **COLD-JUNCTION ACCURACY**
  - measured internal (automatic):
    ±0.4°C ±0.02 × (Tamb-23)°C
  - measured external (in channel NN):
    accuracy of channel NN
  - fixed (at 0°C, 20°C or 50°C):
    T cold-junction - T fixed
    (real c.j. temperature - selected c.j. temperature)

SURVEY OF ACCURACY:

ACCURACY = [**BASIC ACCURACY** + **COLD-JUNCTION CONTRIBUTION =** [**FACTOR F** × **COLD-JUNCTION ACCURACY**]

2.2.3.6 Input

Input configurations	2- and 4-terminal
Maximum voltage between any input terminal and earth or between input terminals for safe operation	42 Vdc or 30 Vac

2.2.3.7 Measuring time

Time to measure one channel	100 ms

2.2.4 PT 100 temperature measurements

2.2.4.1 Measuring principle

Transducer	PT 100 resistance thermometer
Measuring principle	Resistance measurement with or without 10Ω lead compensation
Measuring current	0.7685 mA

2.2.4.2 Range and span

Span	25 ... 1050°C The span is the difference between the selected full scale value FSV and the selected zero scale value ZSV
Full and zero scale limits	−200 ... +850°C

2.2.4.3 Accuracy (transducer excluded)

Accuracy (transducer excluded)	±0.1% of Tin ±0.25°C
Temp. coefficient of accuracy	±0.06 (Tamb-23)°C

2.2.4.4 Linearisation

Linearisation	Acc. to DIN 43760

2.2.4.5 Input

Input configuration	4-terminal input
Maximum voltage between any input terminal and earth or between input terminals for safe operation	42 Vdc or 30 Vac

2.2.4.6 Measuring time

Time to measure one channel	100 ms

2.2.5 Measurement of resistance transducers

To enable resistance measurements, the internal current source (X, Y terminals) can be used to sent a current through the resistor. The voltage drop can be measured on the HI and LO terminal (mV measurement). The specifications of the mV ranges (refer to section 2.2.2) apply also to this measurement.

Additional specification

Transducer resistance	0...3900Ω
Measuring current	0.7685 mA
Accuracy of the current source	±0.015%
Temperature coefficient of the current source	±0.005% per °C
Input configuration	4-terminal

2.2.6 Differential measurements

2.2.6.1 Measuring function

Measuring function	A channel X can be programmed to measure the difference relative to another channel Y. The measurements in both channels are performed according to the measuring function and full and zero scale value of channel Y. The difference is recorded in channel X according to the settings of channel X

2.2.6.2 Accuracy

ACCURACY (CH.X) = BASIC ACCURACY (CH.Y) + ADDITIONAL ERROR + COLD JUNCTION CONTRIBUTION

BASIC ACCURACY (CH.Y) Basic accuracy of the channel against which the difference is measured (ch.Y). Refer to sections 2.2.2, 2.2.3 and 2.2.4.

ADDITIONAL ERROR (see below)

Measuring function	Range	Basic accuracy
Volt	30 V	±0.002% of range
Millivolt	3000 mV 300 mV 30 mV	±0.002% of range ±2 uV
t.c. J, L-type	LOW HIGH	±0.3°C (or ±0.75°C if Tin < −50°C) ±0.5°C
t.c. K-type	LOW HIGH	±0.45°C (or ±1.05°C if Tin < −50°C) ±0.9°C
t.c. S-type	–	±2.16°C
t.c. T, U-type	–	±0.4°C (or ±0.9°C if Tin < −50°C)
PT 100	–	±0.2°C

COLD JUNCTION CONTRIBUTION (only for thermocouples) =

FACTOR Fd × COLD JUNCTION ACCURACY × MEASURED TEMPERATURE DIFFERENCE + ADDITIONAL COLD JUNCTION ERROR (for internal compensation only)

FACTOR Fd (see table)

Type	Range [1]	Fd
J, L	LOW HIGH	22.10^{-4} (293.10^{-4} if Tin < −50°C) 16.10^{-4} (41.10^{-4} if Tin < −20°C)
K	LOW HIGH	29.10^{-4} (327.10^{-4} if Tin < −50°C) 20.10^{-4} (54.10^{-4} if Tin < −20°C)
S	–	56.10^{-4}
T, U	–	39.10^{-4} (241.10^{-4} if Tin < −50°C)

[1] The range of the channel to which the difference is measured.

COLD JUNCTION ACCURACY

- Measured internally (automatic):
  ±0.4°C ±0.02 (Tamb-23)°C
- measured externally (in channel NN):
  accuracy of channel NN
- fixed (at 0°C, 20°C or 50°C):
  Tcold-junction - Tfixed
  (real temperature - set temperature)

ADDITIONAL COLD JUNCTION ERROR

0.35 × F
Only for internal (automatic) cold-junction compensation.
For F refer to section 2.2.3.5.

Survey of accuracy

ACCURACY = [**BASIC ACCURACY (of the channel to which the difference is measured)**
+
ADDITIONAL ERROR = [**FACTOR Fd** × **COLD-JUNCTION ACCURACY** × **MEASURED TEMPERATURE DIFFERENCE (Tdiff)** + **ADDITIONAL COLD-JUNCTION ERROR (only for automatic cold junction compensation)**]
+
COLD JUNCTION CONTRIBUTION (only at thermo-couple measurements)

2.3 ACCESSORIES

Delivered with the instrument are:

- A package of 5 books fan-folded thermosensitive paper (20 m each), black imaging.
- 2 fuses 1.6 A-T.
- A mains cord.
- A paper collection tray, refer to section 3.1.3.
- A program module, refer to section 5.2.
- An operating manual 'PM8238 , MULTIPOINT DATA RECORDER'
- An operating manual 'PM8238, INTERFACES TO OTHER DEVICES'

2.4 OPTIONS

2.4.1 Survey and ordering information:

OPTION	ORDERING NUMBER	COMMENTS
3 PROGRAM MODULES	PM9141/02	
IEC 625 INTERFACE	PM9891/02	Not in combination with each other
IEC 625 INTERFACE with IEEE 488 adapter	PM9891/21	
RS232-C/V24 INTERFACE	PM9890/02	
EXTENDED CONTROL INTERFACE	PM9893/01	
ALARM OPTION	PM9895/02	to be installed in the factory!

THERMOCOUPLE LINEARISATION UNITS		
Pt 13 %Rh - Pt	PM9897/01	0... + 1768°C
Pt 30 %Rh - Pt 6 %Rh	PM9897/11	+ 250... + 1820°C
NiCr - CuNi	PM9897/21	− 200... + 400°C
NiCr - CuNi	PM9897/31	− 100... + 1000°C
Nicrosil - Nisil	PM9897/41	0... + 800°C
Nicrosil - Nisil	PM9897/51	0... + 1200°C
Ni - Ni 18 % Mo	PM9897/61	0... + 1400°C
19'' RACK MOUNT KIT	PM9838/20	

2.4.2 Set of 3 program modules

The program modules can be used to store the recorder settings. With these modules, a recorder can be quickly loaded with another measuring program. For operating instructions refer to section 5.2.

2.4.3 Interfaces to other devices

2.4.3.1 IEC 625/IEEE 488, RS232C/V24 interface

The IEC 625/IEEE 488 and RS232C/V24 interfaces can be used to:

- operate the instrument remotely
- output measuring results
- output the channel parameter settings; the data can be used to program the recorder
- print externally supplied data on the chart

Only one of these interfaces can be installed in the instrument; they can not be used in combination with the EXTENDED CONTROL interface.

For operating instructions refer to the manual 'PM8238 INTERFACES TO OTHER DEVICES' (supplied with).

2.4.3.2 Extended control interface

This interface offers the following additional control possibilities:

- chart speed control via externally supplied pulses
- increase the chart speed by a factor of 10
- scan command, to measure all channels once
- step command, to measure the next channel once
- event marker, to print a marking at the left margin
- end of paper detection

The EXTENDED CONTROL interface can not be used in combination with an IEC 625/IEEE 488 or RS232C/V24 interface.

For operating instructions refer to the manual 'PM8238 INTERFACES TO OTHER DEVICES' (supplied with).

2.4.4 Alarm option

This option offers a minimum-alarm relay and a maximum-alarm relay for each of the 15 odd numbered or 15 even numbered channels, depending on its location in the instrument. Alarm relays for all channels, require 2 alarm options.

The alarm options must be installed in the factory or by your local Philips Service Organisation.

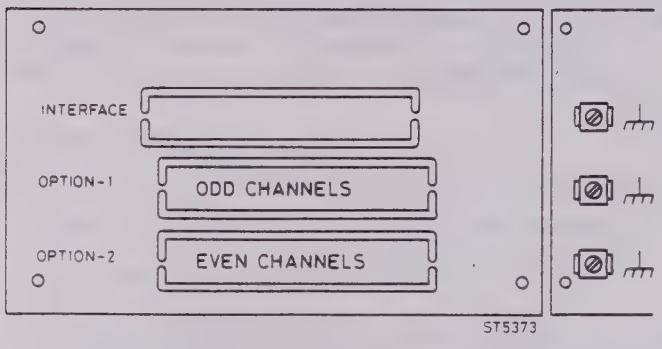


Fig. 1. Alarm option location at the rear.

OPERATION

The alarm relays will only be activated when the Q-digit of the channel parameter RESPONSE TO ALARM is set to 1 (see section 5.5.1.6).

An alarm relay contact is closed if the input signal is above or below the maximum- or minimum alarm level respectively.

Connector pinning

MIN. ALARM	COMMON	MAX. ALARM	CHANNEL NUMBER	
ST5374			OPTION1 (ODD)	OPTION 2 (EVEN)
50		17	not connected	
49	33	16	not connected	
48	32	15	29	30
47	31	14	27	28
46	30	13	25	26
45	29	12	23	24
44	28	11	21	22
43	27	10	19	20
42	26	9	17	18
41	25	8	15	16
40	24	7	13	14
39	23	6	11	12
38	22	5	9	10
37	21	4	7	8
36	20	3	5	6
35	19	2	3	4
34	18	1	1	2

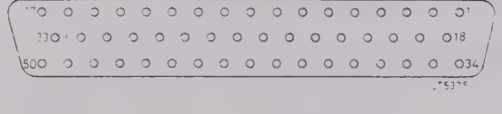


Fig. 2. Alarm option connector

Contact ratings:

- switched power	10 W max.
- switched voltage	42 Vdc or 30 Vac max.
- switched current	500 mA, dc or ac (rms) max
- maximum voltage between contacts and earth	42 Vdc or 30 Vac (rms)
- time between alarm and contact closure	Depends on the number of measured channels.
- time between alarm off and contact opening	Refer to section 5.5.1.6 'RESPONSE TO ALARM'
- current through closed contacts	2 A, dc or ac (rms) max.
- contact resistance	50 mΩ

2.4.5 Thermocouple linearisation units

Detailed information is supplied with the linearisation unit.

2.4.6 19'' rack mounting brackets

To mount the PM8238 in a 19'' rack, the set of mounting brackets PM9838/20 can be used.
The ambient temperature (including heat radiation from adjacent equipment) should remain within −10°C and +50°C (+5 ... +50°C for specified accuracy).

INSTALLATION

The brackets must be fixed against the side of the recorder:
- remove the top cover fixing screws (2x at each side)
- if required, the recorder feet can be removed (remove the rubber isert first)
- fix the brackets

Fig. 3. PM8238 with 19'' mounting brackets.

2.5 RECORDING PAPER

Ordering number PM9930A/03.
A package of 5 books fan-folded thermosensitive paper. Each book has a length of 20 m.
The scale is linear, form 0 - 100.

3. PREPARATIONS FOR USE

3.1 INSTALLATION

3.1.1 Initial inspection

Check the contents of the shipment for completeness (see section 2.3) and note whether any damage has occurred during transport. If there is damage, a claim should be filed with the carrier immediately. In this case, and also if the contents are incomplete, the Philips Sales or Service organisation should be notified in order to facilitate the repair or replacement of the instrument.

3.1.2 Transit securities

After unpacking the instrument the transit securities (Fig.4) must be removed:

- Loosen the screws (item 1) identified by the red labels.
  The transparent chart guide plate (item 2) can be hinged upwards. Remove the screws and the spacers (item 3); the cassette will now hinge out.

The carriage is fixed with a cord (item 4).

- Remove the carriage fixing cord (item 4) by pulling it out.

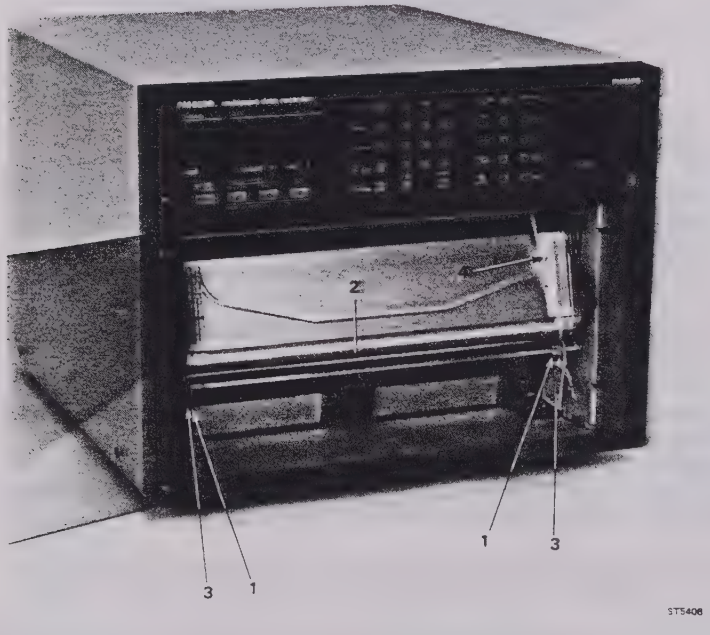


Fig. 4. Transit securities

3.1.3 Mounting the paper collection tray (Fig. 5, item 1)

The paper collection tray, delivered with the instrument, can now be mounted.

- The cassette must first be hinged out by pulling forward the two black quadrant-shaped side plates. Note the two pivot studs (item 2) on these side plates for locating the paper collection tray.
- Locate the two holes in the collection tray over these studs by applying slight outward pressure to spring the ears of the tray over the studs.
- Lift the front side of the collection tray and insert it, keeping the tray horizontal. The cassette will snap into its locked position.
- The cassette can be unlocked again by lifting the front side of the collection tray.
- The chart can be loaded as described in section 3.1.4.

Fig. 5. Mounting the paper collection tray

3.1.4 Loading the chart (Fig. 6 + 7)

To load the chart proceed as follows:

- If the recorder is switched on, select the STANDBY mode by pressing the STANDBY key.
- Hinge upwards the transparent guide plate (item 1).
- Lift the front side of the paper collection tray; the cassette will turn over now.
- Pull the collection tray outwards until the chart feed tray behind the cassette is visible.
- Shake both ends of the chart several times to avoid overlapping during chart transport; see Fig. 7.
- Place the fold book horizontally into the supply tray with the round holes as far as possible to the left hand side.
- Slide the chart out as far as the collection tray.
- Tilt the collection tray in the horizontal position and insert it until the cassette snaps into its fixed position.
- Position the chart in such a way that the sprocket pins on the chart drive belt engage the sprocket holes in the chart and the time division lines are horizontal.
- Fold down the transparent guide plate.
- Ensure that the first two fan folds are correctly folded into the collection tray; the direction of folding when fed to the collection tray should be the same as the folding of the supply book.

NOTES:

- *Do not use the transparent guide plate as a tear-off rule. The chart should be torn off at its perforations.*
- *When the chart is torn off during recorder operation, ensure again that the first two chart folds are correctly folded into the collection tray, as previously mentioned.*
- *If required, the complete fold-book can be removed from the recorder by first placing back the used part from the collection tray into the supply tray. The complete fold-book can now be taken out of the supply tray.*
- *The special recording chart is slightly sensitive to the influence of sunlight. It is therefore recommended that the recording chart (stock) and important recordings are stored in a dry dark place.*
- *Do not expose the chart to temperatures above 60°C.*

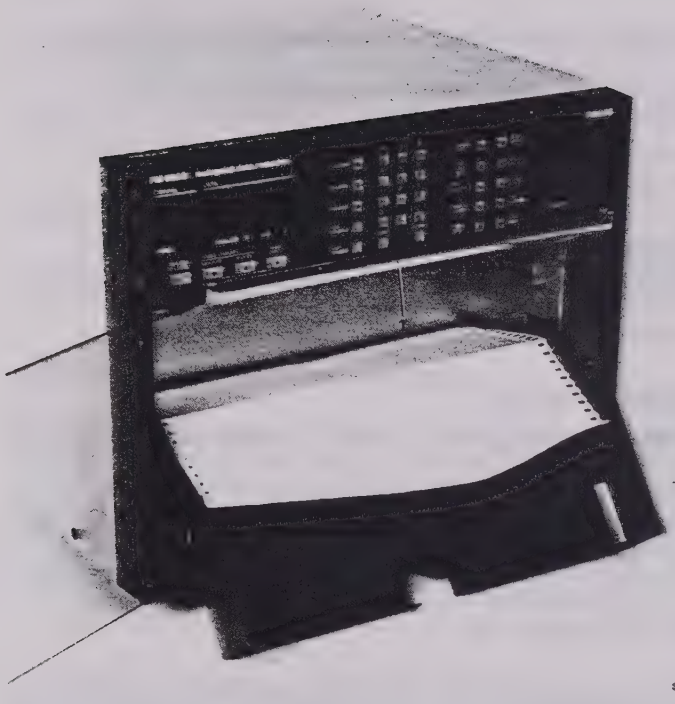


Fig. 6. Loading the chart; cassette turned out.

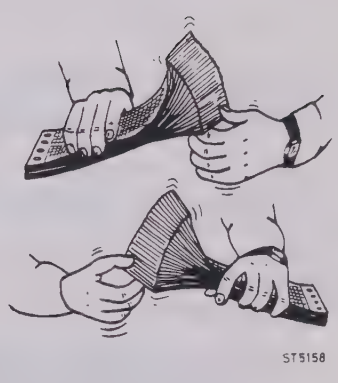


Fig. 7. Shake both ends of the chart

3.1.5 Inserting the program module

Insert the program module, the rear connector at the lower side!

3.2 MAINS SUPPLY

3.2.1 Safety instructions

- Before any other connection is made the protective earth shall be connected to a protective conductor (see 'Earthing').
- Before inserting the mains plug into a mains socket ensure that the instrument is set to the correct local mains voltage. Refer to the type plate at the rear of the instrument.

3.2.2 Earthing

The instrument shall be connected to a protective earth connector via a three core mains cable.
The mains plug shall only be inserted into a socket outlet provided with an earth contact. The protective action shall not be made ineffective by the use of an extension lead without a protective conductor. Replacing the mains plug is at the users own risk.

Any interruption of the protective conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to make the instrument dangerous. Intentional interruption is prohibited.
When the instrument is brought from a cold into a warm environment, condensation may cause a hazardous condition. Make sure that the earthing requirements are strictly adhered to.

3.2.3 Connecting to the mains

The power switch is located at the rear. When the instrument is switched on it will behave as described in section 5.1.

3.2.4 Replacing the mains fuse

The instrument is provided with one mains fuse. It is located in the combined mains socket/fuse holder at the rear side.
Make sure that only fuses with the required rated current and of the specified type are used.
Disconnect the instrument form the mains before replacing the fuses.

Mains voltage	Required fuse
220 - 240 V 110 - 170 V	1.6 A-T (slow blow)

The use of make-shift fuses and the short circuiting of fuse holders are prohibited!

3.2.5 Adaptation to the local mains voltage and frequency

If the recorder must be adapted to another mains voltage or frequency please contact your local dealer.

3.3 REPLACING THE PROGRAM MODULE BATTERY

The program module is powered by a miniature LITHIUM battery to prevent loss of information at power off. The battery life time is 5 years.
For replacement of the battery proceed as follows (Fig. 8):

- Remove the topcover (2 screws).
- Pull out the printed circuit board and unsolder the battery.
- Fit the new battery. Make sure that the polarity is correct.

Battery specifications:

V nominal	- 3 V
Model	- coin, 23 × 2.5 mm
Ordering number	- 5322 138 10088
Capacity	- 160 mAh

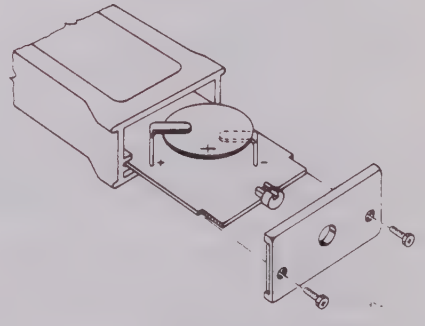


Fig. 8. Battery location

4. CONNECTING THE TRANSDUCERS, ALARM OUTPUT

4.1 INPUT TERMINALS

The screw terminals at the rear of the recorder are suitable for flexible leads of 2 × 1.5 mm² including end crimps. Alternatively, the use of flat-pin terminals (DIN 46244) is possible:

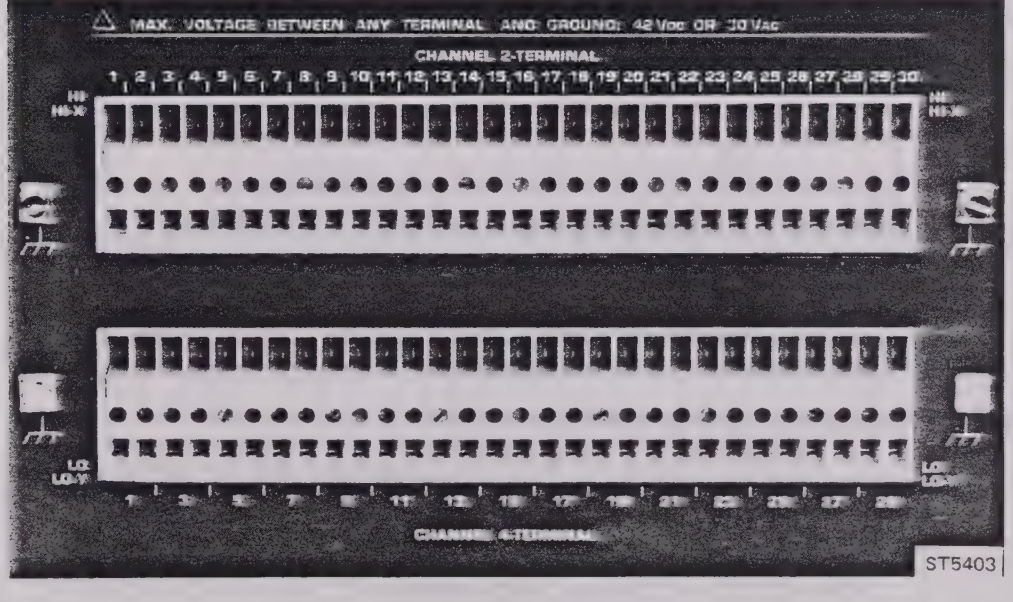
1 terminal A 6.3 × 0.8 or
2 terminals A 2.8 × 0.8

4.2 SIGNAL LEADS

To prevent stray electrical or magnetic interference, we recommend using twisted and screened leads. The screen must be connected to ground (⏚, see also section 4.3.).

4.3 2-TERMINAL OR 4-TERMINAL CHANNELS

The recorder has 30 rows of 2 input terminals each. When setting the CHANNEL MODE (section 5.5.1.2), a channel can be made 4-terminal or 2-terminal.
Only an odd channel (n) can be made 4-terminal; it then occupies 2 rows of input terminals. In this case the even numbered channel (n + 1) does not exist.
When the odd channel n is programmed as a 2-terminal channel, the even numbered 2-terminal channel n + 1 does exist.
An even numbered channel n + 1 has the same settings as the odd numbered channel n, except for the CHANNEL MODE and RESPONSE TO ALARM.


MAX. VOLTAGE BETWEEN ANY TERMINAL AND GROUND: 42 Vpc OR 30 Vac
CHANNEL 2-TERMINAL
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
ST5403

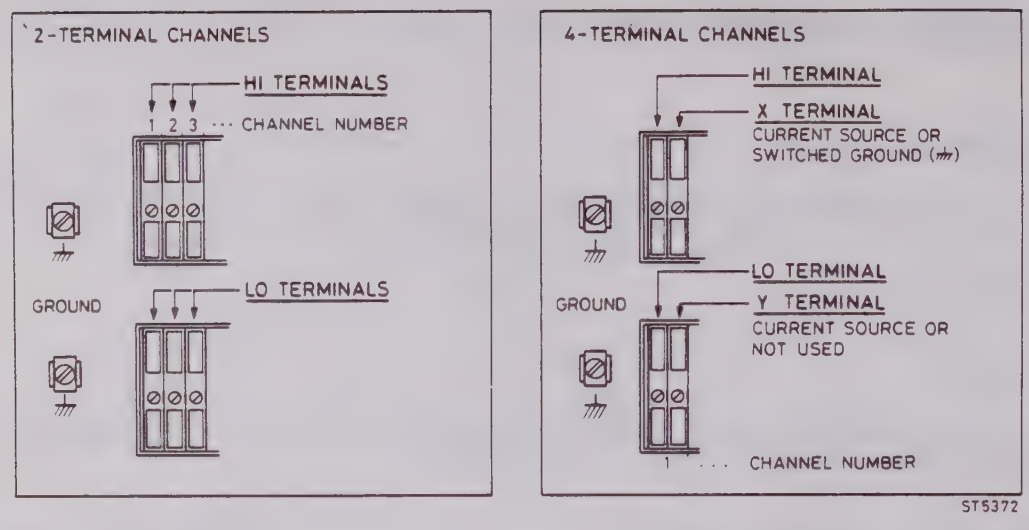


Fig. 9. Input channels

GROUND:

The four common-ground terminals are permanently connected to instrument earth (⏚). At mV, V and thermocouple measurements the X-terminal of a 4-terminal channel is connected to instrument earth when the relevant channel is measured.

4.4 VOLTAGE MEASUREMENTS (V AND mV)

Connect the voltage source as shown in Fig. 10.

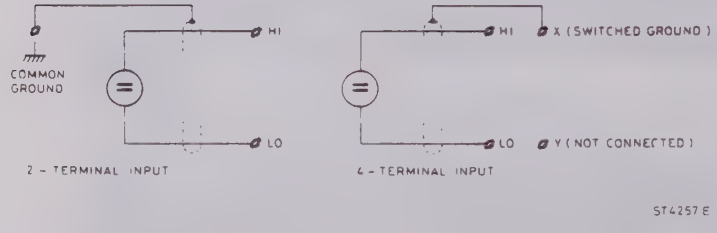


Fig. 10. Voltage source connections

4.5 TEMPERATURE MEASUREMENTS WITH THERMOCOUPLES

Connect the thermocouples as shown in Fig. 11. For thermocouple break detection refer to section 5.3.

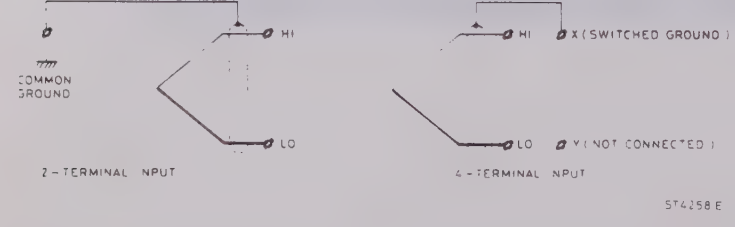


Fig. 11. Thermocouple connections

The following types of cold junction compensation are possible (see figure 12).

1) **Automatic**
The cold junction is the junction between the thermocouple (or compensating leads) and the input terminals. The temperature of the input terminals is measured periodically and used for cold junction compensation.

2) **Measured externally**
The cold junctions are located in an isothermal box.
The cold junction temperature is measured in another channel.
Compensation is done with that measured temperature.
The leads between the cold junction and the recorder must be copper.

3) **Fixed**
The cold junction must be at a fixed temperature of 0°C, 20°C, or 50°C. The instrument can be programmed to compensate for one of these temperatures.
The leads between the cold junction and the recorder must be copper.

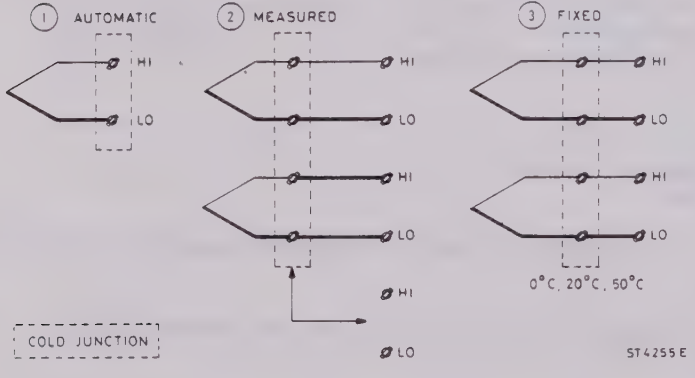


Fig. 12. Cold junction compensation

4.6 PT 100 TEMPERATURE MEASUREMENTS

The recorder can be programmed to perform PT 100 measurements with or without 10 Ω lead compensation.

The PT 100 transducer can be connected as follows (see Fig. 13):

1) 4-wire connection; the lead resistance does not influence the measuring result.

2) 2-wire connection; the lead resistance must be adjusted to 10 Ω with a variable resistor Ra.

3) 3-wire connection; the lead resistance must be adjusted to 10 Ω with a variable resistor Ra.

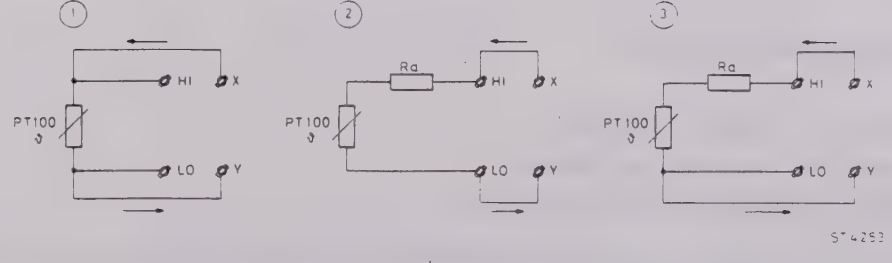


Fig. 13. PT 100 connections

The lead resistance can be adjusted as follows:

- Short circuit the input leads at the connections of the PT 100 resistance thermometer (Fig. 14a.).

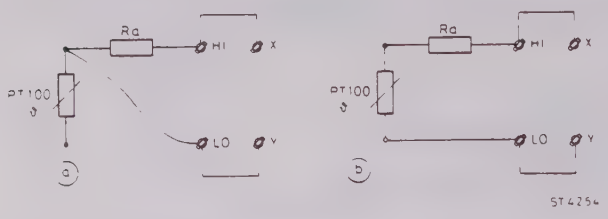


Fig. 14. Adjustment of lead resistance

- Select the POGRAM MODE.
- Program the recorder as follows:
  - select the required channel number
  - set CHANNEL MODE 411 (4-wire measurement)
  - set MEASURING FUNCTION 1200 (mV with current source)
  - set ZERO SCALE VALUE +7.685
  - set FULL SCALE VALUE 0
- Select dot print mode (NUM PRINT off)
- Select CHART DRIVE +40 (chart speed 40 mm/min)
- Select SINGLE CHANNEL MEASURE
- Select the MEASURE mode
- Adjust Ra until the recorder prints at the zero position on the chart, without indicating E31 on the display (the displayed value must be 7.68 mV).

Reconnect the input lead to the PT 100 resistance thermometer (Fig. 12b). The recorder is ready for PT 100 measurements after it is reprogrammed.

4.7 MEASUREMENT OF RESISTANCE TRANSDUCERS

Connect the resistance transducer in one of the following ways (Fig. 15):

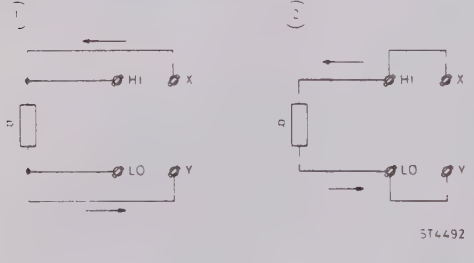


Fig. 15. Connecting resistance transducers

1) 4-wire measurement (lead resistance eliminated).

2) 2-wire measurement (lead resistance also measured).

The measured voltage is R x 0.7685 mV (R in ohms).

The maximum measurable resistance value is 3900 Ω (for stated accuracy), which results in a measuring result of 3000 mV. The measuring result is indicated in mV!

4.8 ALARM OUTPUT

A maximum- and a minimum alarm relay is provided. An alarm relay contact is closed if a maximum alarm level is exceeded or if the input signal drops below the minimum alarm level. It is operative for all channels programmed to react on alarm via these relays.
Refer also to section 5.5.1.6 'RESPONSE TO ALARM'.

Contact ratings:

- switched power	10 W max.
- switched voltage	42 Vdc or 30 Vac max.
- switched current	500 mA, dc or ac (rms) max.
- maximum voltage between contacts and earth	42 Vdc or 30 Vac (rms)
- time between alarm and contact closure	Depends on the number of measured channels.
- time between alarm off and contact opening	Refer to section 5.5.1.6 'RESPONSE TO ALARM'
- current through closed contacts	2 A, dc or ac (rms) max.
- contact resistance	50 mΩ

Fig. 16. Alarm output

5. MANUAL OPERATION (LOCAL)

5.1 SWITCHING ON

When connecting the recorder to the mains, the safety instructions, section 3.2.1 should be adhered to. The mains switch is located at the rear.

After power-on, the recorder first performs a self-test.

Then it will print:
'INPUT BLOCK TEMPERATURE ... DEG.C'.
At an erroneous situation an error code will be given (refer to section 6)

If the recorder starts up in the MEASURE mode it will also print the time, date and chart drive setting.

5.2 PROGRAM MODULE

5.2.1 Description

The battery powered program module saves the settings of the recorder during power-off. It can be removed and be kept outside the recorder. It will store the settings of the recorder for at least five years. On delivery the module is loaded with a factory test program.

The recorder is loaded with the contents of the program module:

- at power-on
- when the STANDBY mode is left by pressing 'MEASURE' or 'PROGRAM'.

The program module is loaded with the recorder settings:

- when the settings are changed
- when the STANDBY mode is selected
- every minute

The module can be protected from being overwritten, refer to section 5.2.2.

5.2.2 Write protection (Fig. 17)

A jumper plug inserted at the top of the program module protects a part of its contents from being overwritten. The ALARM LEVEL settings and CHART DRIVE settings are NOT WRITE PROTECTED. When the module is write protected, the protected functions can be viewed but not be changed. The jumper plug can be removed, turned through 180° and inserted again to enable or disable writing. When jumper plug is left out, the write protection is effective.

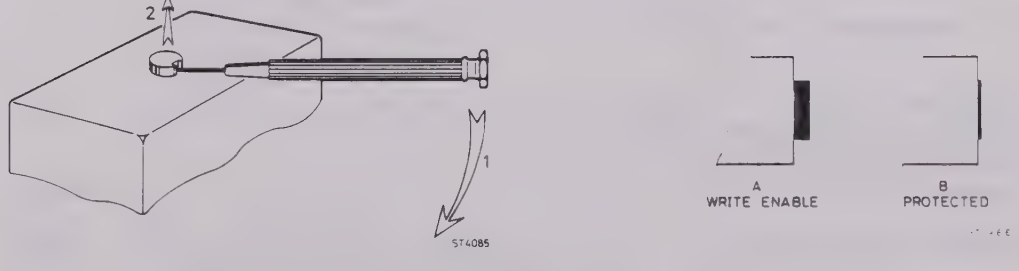


Fig. 17. Program module, write protection

In the 'protected' state (B), a sticker for identification can be fixed on top of the module.

5.2.3 Programming the recorder by means of a program module

- select the STANDBY mode.
- remove the program module and insert a pre-loaded one.
- select the PROGRAM or MEASURE mode.

5.2.4 Copying program modules

- select the PROGRAM mode.
- remove the program module and insert a new one (not write protected!).
- select the STANDBY mode; the program module is loaded now with the recorder program, which is equal to the program in the removed module.
- make the module write protected, see section 5.2.2.

5.3 THERMOCOUPLE BREAK DETECTION

The recorder can detect a thermocouple break by sending a 0.8 mA direct current through the thermocouple and measuring the voltage drop. This current can influence other equipment connected to the same thermocouple. The thermocouple break detection can be switched on or off as described in section 5.5.1.3.

A thermocouple break is indicated in the following ways:

- E34 on the display
- in the numeric print mode OC (open circuit) is printed as a measurement result.

NOTE: in the dot mode a channel in which a break is detected will not be recorded.

5.4 FRONT PANEL CONTROLS

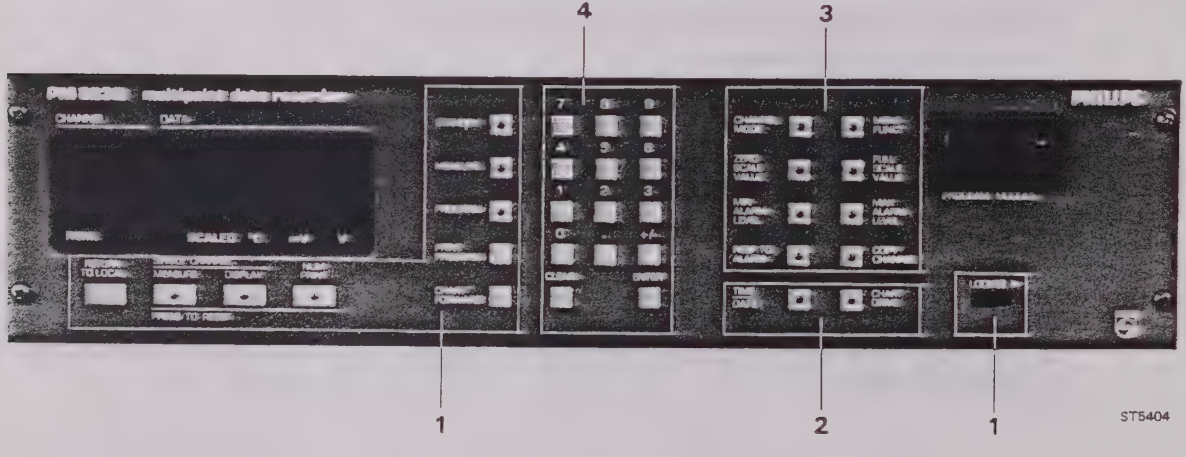


Fig. 18. Front panel

1) **OPERATING KEYS**
2) **INSTRUMENT PARAMETER KEYS**
3) **CHANNEL PARAMETER KEYS**
4) **NUMERIC KEYS**

The green coloured functions are:

- not write protected, see section 5.2.2 (ALARM LEVEL and CHART DRIVE settings)
- operable in the PROGRAM as well as the MEASURE mode.

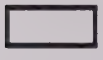
Front panel control is only possible when the recorder is in the local state (i.e. not controlled via an IEEE 488/IEC 625 or RS232C/V24 interface).

5.4.1 Operating keys (1)

LOCKED

RIGHT POSITION : front panel control disabled (LOCKED)
LEFT POSITION : front panel control enabled.

RETURN TO LOCAL



Only to be used if a remote control interface option is installed.

STANDBY

ON : press if LED indication is off
OFF: press MEASURE or PROGRAM key

ON : The instrument is in the STANDBY mode, i.e. not measuring and not recording; programming is disabled.
The following actions can be carried out:

- Numerals can be printed on the chart by pressing the keys:
  0...9 – numerals
  CLEAR – space
  ENTER – carriage return + line feed
  . – dot
  +/– – oblique stroke
- By pressing the PRINT PROGRAM key the channel parameter settings are printed on he chart.

OFF: the instrument is in the MEASURE or PROGRAM mode.

MEASURE

ON : press if LED indication is off
OFF: press STANDBY or PROGRAM key

ON : The recorder MEASURES:
- if SINGLE CHANNEL MEASURE indication is off, all channels (as far as not skipped and correctly programmed)
- if SINGLE CHANNEL MEASURE indication is on, one channel

The recorder DISPLAYS:
- if SINGLE CHANNEL DISPLAY indication is off, all measured channels
- if SINGLE CHANNEL MEASURE or SINGLE CHANNEL DISPLAY are on, one channel

The recorder RECORDS:
- The measurement results as dotted lines or in numeric tables when the NUM PRINT indication is off or on respectively.

OFF: the recorder is in the STANDBY or PROGRAM mode

PROGRAM

ON : press if LED indication is off
OFF: press MEASURE or STANDBY key

ON : The recorder can be programmed and operated (the LOCKED switch must be in the left position and the program module must not be write protected). The instrument is not measuring and not recording.

OFF: the recorder is in the STANDBY or MEASURE mode

SINGLE CHANNEL MEASURE

ON : press if LED indication is off
OFF: press if LED indication is on

ON : Only one channel is measured, recorded and displayed.

OFF: All channels not skipped and properly programmed are measured and recorded; the display shows the measurement result of all or one of the measured channels (SINGLE CHANNEL DISPLAY).

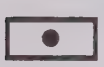
SINGLE CHANNEL DISPLAY

ON : press if LED indication is off
OFF: press if LED indication is on or
press SINGLE CHANNEL MEASURE

ON : One of the measured channels can be selected to be continuously displayed.

OFF: all measured channels are displayed.

NUM PRINT



ON : press if LED indication is off
OFF: press if LED indication is on

ON :
- in the MEASURE mode the measuring results are recorded as numeric tables (numeric print mode)
- in the PROGRAM and MEASURE mode the print interval time can be set.

OFF:
- in the MEASURE mode the measuring results are recorded as dotted lines only or as a combination of dotted lines and numerals (dot print mode).
- in the PROGRAM and MEASURE mode the chart speed can be set.

PRINT PROGRAM

When the PRINT PROGRAM key is pressed, the channel parameter settings are printed on the chart.

Printing the settings can be stopped by pressing the STANDBY key.

CHART FORWARD

The chart is driven in the forward direction as long as this key is pressed.
The chart speed increases up to 1666 mm/min.

5.4.2 Instrument parameter keys (2)

TIME/DATE

ON : press if LED indication is off ⟶ TIME is displayed
change TIME and press ENTER ⟶ DATE is displayed
change DATE and press ENTER ⟶ YEAR is displayed
change YEAR and press ENTER ⟶ indication OFF.

OFF: press ENTER until the indication is OFF

The TIME, DATE and YEAR can be set only in the PROGRAM mode.

NOTE: *+ TIME, numeric print out in dot mode*
– TIME, no numeric print out in dot mode

CHART DRIVE

ON : press if LED indication is off
OFF: press ENTER key

ON :
- in dot print mode (NUM PRINT off) the CHART SPEED is displayed and can be changed.
- in numeric print mode (NUM PRINT on) the PRINT INTERVAL TIME is displayed and can be changed.

CHART DRIVE can be set in the PROGRAM and MEASURE mode.

NOTE 1: in the dot print mode with chart feed clock pulses via the EXTENDED CONTROL option, the dividing factor for the clock pulses in displayed and can be changed. Refer to the manual 'PM8238 INTERFACES TO OTHER DEVICES'

NOTE 2: The write protection on the PROGRAM MODULE is not effective for the CHART DRIVE settings.

5.4.3 Channel parameter keys (3)

A channel parameter can be selected by pressing the corresponding key, when the PROGRAM mode is selected. A channel parameter is switched off by pressing the ENTER key or by pressing another key provided with a LED indication.

CHANNEL MODE

- channel is 4-terminal or 2-terminal
- channel is measured or skipped
- in the dot mode measurement results are:
  - not printed
  - printed with one dot
  - printed with a special marking
  - printed with interpolated dots

MEASURING FUNCTION

- voltage (mV, V)
- scaled voltage (mV, V)
- temperature, PT100 or thermo couple
- differential measurement
- type of cold-junction compensation
- mV measurement with current source (resistance transducers)

ZERO SCALE VALUE

- value to be recorded at 0% of scale

FULL SCALE VALUE

- value to be recorded at 100% of scale

MINIMUM ALARM LEVEL

- a minimum alarm is given when the input signal drops blow this level
  - chart speed *10
  - activate alarm relays
  - print with special marking

MAXIMUM ALARM LEVEL

- a maximum alarm is given when the input signal exceeds this level

RESPONSE TO ALARM

- type of alarm indication

COPY CHANNEL

- the channel parameters of the current channel can be set according to the settings of another channel, except for the CHANNEL MODE and RESPONSE TO ALARM.

NOTE: When the PROGRAM MODULE is write protected the channel parameters cannot be changed except for the ALARM LEVELS. The write protection is not effective for the ALARM LEVEL settings.

5.4.4 Numeric keys(4)

0 ... 9	Figure 0 ... 9
.	Dot, decimal point
+/−	+ or − sign, press to change sign. In the STANDBY mode an oblique stroke is printed.
CLEAR	Data part of the display is cleared; the memory is not cleared. In the STANDBY mode a space is created on the paper.
ENTER	At PROGRAMMING the displayed data are entered into the memory and the selected channel parameter or instrument parameter is switched off. In the STANDBY mode a CR/LF (carriage return and line feed) is executed. In the PROGRAM mode, the SINGLE CHANNEL MEASURE mode and the SINGLE CHANNEL DISPLAY mode, a keyed in channel number is selected.

5.5 PROGRAMMING INSTRUCTIONS

Programming the recorder exists of:

- Setting the CHANNEL PARAMETERS (section 5.5.1)
- Setting the INSTRUMENT PARAMETERS (section 5.5.2)

5.5.1 Setting the channel parameters

5.5.1.1 PROCEDURE

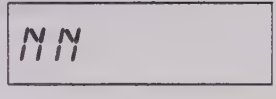
SELECT THE PROGRAM MODE:

PROGRAM

- Set the front panel control disable switch (LOCKED) in the left position.
- Press the PROGRAM key if its LED indication is off.
  The PROGRAM mode is selected now. The current channel number is indicated in the display.
- Remove the write protection of the PROGRAM MODULE to enable all channel parameters to be changed (refer to section 5.2.2)

SELECT THE NUMBER OF THE CHANNEL TO BE PROGRAMMED:

CHANNEL DATA



To select the NEXT CHANNEL in succession:

- Press the PROGRAM key

To select an ARBITRARY CHANNEL:

- Key in the channel number (the number is displayed under DATA)
- Press the ENTER key (the number is displayed under CHANNEL)

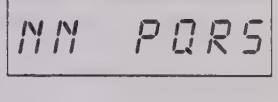
NOTES:

- *If a channel parameter or an instrument parameter is selected it first must be switched off:*
  - *Press the CLEAR key to clear the DATA display*
  - *Press the ENTER key to switch off the parameter*

  The required channel number can now be selected
- *When an odd numbered channel n is programmed as a 4-terminal one, the even numbered channel n + 1 does not exist. Trying to select a non-existing channel results in error code E11 or E12.*

SELECT THE CHANNEL PARAMETER TO BE CHANGED:

CHANNEL DATA

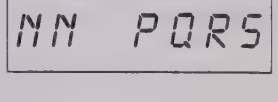


- Press the required CHANNEL PARAMETER key.
  For a description of the channel parameters see sections 5.5.1.2 up to 5.5.1.7.

When a CHANNEL PARAMETER is selected, the display will show the current channel number and its settings. The settings consist of up to four digits, called the P, Q, R and S digit.

KEY IN THE REQUIRED SETTING:

CHANNEL DATA

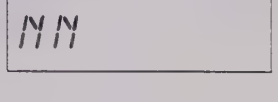


- Press numerals according to this setting.
  Up to 4 numerals (P, Q, R, S) must be keyed in

The DATA display can be cleared by pressing the CLEAR key. The setting in the memory is not cleared then.

ENTER THE SETTING INTO THE MEMORY:

CHANNEL DATA



- Press the ENTER key, the displayed setting is entered into the memory.

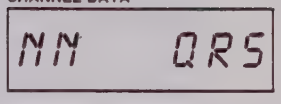
  The data display and channel parameter LED indication are blanked.

  NOTE: for ERROR CODES (E..) refer to section 6.

5.5.1.2 CHANNEL MODE

CHANNEL MODE

CHANNEL DATA



- **Press three numeric keys to set the Q, R and S digit.**
- **Press the ENTER key.**

SPECIFICATION OF THE Q, R AND S DIGIT

Q = 4 : 4-terminal input configuration.

The channel has four input terminals viz.:
- for thermocouples and voltages: HI, LO, X (switched GROUND) and Y (not used).
- for PT 100 measurement and mV measurements with current source: HI, LO, X (current) and Y (current).

Only odd numbered channels can be programmed in 4-terminal input configuration!

Q = 2 : 2-terminal input configuration.

The channel has two input terminals viz. HI and LO, for voltage and thermocouple measurements with common GROUND.
Odd and even numbered channels can be programmed in this configuration. The odd and associated even numbered channel are programmed automatically according to the same settings, except for CHANNEL MODE and RESPONSE TO ALARM.

NOTE: An even numbered channel is said not to exist when the related odd numbered channel is programmed in the 4-terminal input configuration.

R = 1 : The channel is measured

R = 0 : The channel is skipped (not measured).

S = 0 : The channel is not recorded in the dot mode

The channel is measured but not recorded.
In combination with RESPONSE TO ALARM a channel can be recorded only on alarm, refer to section 5.5.1.6.

S = 1 : In the dot print mode each recorded measurement result of the current channel is represented by a single dot.

S = 2 : In the dot print mode each recorded measurement result of the current channel is represented by a special marking.

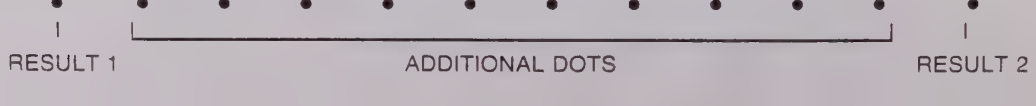
For the special markings the channels are divided in 6 groups of 5 channels each. All channels of one group are recorded with the same marking. This marking consists of 2 or 3 dots, the lower left point indicates the measurement result. The table below shows the groups of channels and their marking.

CHANNELS	MARKING	CHANNELS	MARKING
1, 7, 13, 19, 25	● ○ ● ●	4, 10, 16, 22, 28	○ ● ● ●
2, 8, 14, 20, 26	● ● ○ ●	5, 11, 17, 23, 29	○ ○ ● ●
3, 9, 15, 21, 27	● ● ● ○	6, 12, 18, 24, 30	● ○ ● ○

○ dot is not printed
● dot is printed

S = 3 : In the dot print mode each recorded measurement result of the current channel is represented by a single dot. In addition INTERPOLATED dots will be printed.

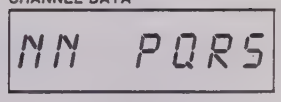
If two successive printed measurement results are greater than 1,75 mm apart, additional dots will be printed between them.



5.5.1.3 MEASURING FUNCTION: °C, mV, V SCALED, DIFFERENTIAL

MEAS. FUNCT.

CHANNEL DATA



- **Press four numeric keys to set the P, Q, R and S digit.**
- **Press the ENTER key**

NOTE: The MEASURING FUNCTION can be set in an even or odd numbered channel. For the even and related odd numbered channel the MEASURING FUNCTION becomes the same.

SPECIFICATION OF THE P, Q, R and S digit

DIFFERENTIAL MEASUREMENTS

P Q R S

0 0 N N : Differential measurement against channel NN.

The measurement result in channel NN is subtracted from the result of the current channel. The difference is recorded and displayed in the current channel.
The measurement of the current channel is performed using the FULL and ZERO SCALE VALUE and MEASURING FUNCTION of channel NN.
The difference is recorded using the settings of the current channel.

Example:

The difference between channel 1 and channel 3 must be measured.

Channel 1 : voltage source, output voltage 0 ... + 10 V
Channel 3 : voltage source, output voltage 0 ... + 10 V
The expected difference is −0.5 ... +0.5 V.

SETTINGS	CH. 1	CH.3	COMMENTS
CHANNEL MODE	211	211	2-terminal
MEASURING FUNCTION	1500		voltage measurement
MEASURING FUNCTION		0001	difference against ch.1
ZERO SCALE VALUE	−0000	−000.5	volt
FULL SCALE VALUE	+0010	+000.5	volt

Channel 1 is measured and recorded using its own settings.
Channel 3 is measured using the measuring function and full and zero scale value of channel 1. The resolution of channel 1 (0.1 %, is 10 mV) influences also channel 3. The resolution of the difference is also 10 mV.
This difference is recorded using the settings of channel 3, i.e. −0.5 V for the zero scale position and +0.5 V for full scale.
The span of channel 3 is 1 V and the resolution of the measured voltage is 10 mV. This means that the minimum distance between two dots in the dot print mode in channel 3 is:

$$\frac{10\ \text{mV}}{1\ \text{V}} \times 250\ \text{mm} = 2.5\ \text{mm}$$

The ALARM LEVEL and RESPONSE TO ALARM settings of channel 3 are related to the determined difference.

NOTE: Nesting of difference measurements is not allowed e.g.

channel 1: voltage measurement
channel 3: differential measurement to channel 1.
channel 5: differential measurement to channel 3.

The differential measurement in channel 5 is cancelled and error code E25 will be displayed.

VOLTAGE MEASUREMENTS

P Q R S

1 0 0 0 : Millivolt measurement.
1 2 0 0 : Measurement of resistance transducers, see section 4.7. Odd channels only!
1 5 0 0 : Volt measurement.

SCALED VOLTAGE MEASUREMENTS

P Q R S

1 0 0 1 : Scaled mV measurements
1 5 0 1 : Scaled V measurements

The numeric representation of the measured voltage will be scaled. For setting the scale and for more information refer to section 5.5.1.4

PT 100 MEASUREMENTS

P Q R S

2 0 0 0 : PT 100 temperature measurements (see section 4.6). Odd channels only!
2 1 0 0 : PT 100 temperature measurements with 10Ω lead compensation (see section 4.6). Odd channels only!

THERMOCOUPLE MEASUREMENTS

+ P Q R S : Thermocouple break detection on.
– P Q R S : Thermocouple break detection off.
Refer also to section 5.3.

P Q R S

P . . . : The P digit indicates the THERMOCOUPLE TYPE.

3 . . . : Thermocouple linearisation option, refer to section 2.4.
4 . . . : J-type; iron - constantan (Fe - CuNi; IEC 584-1, IPTS-68).
5 . . . : L-type; iron - constantan (Fe - CuNi; DIN 43710).
6 . . . : K-type; chromel - alumel (NiCr - NiAl; IEC 584-1, IPTS-68).
7 . . . : S-type; platinum - platinum 10% rhodium (Pt - Pt 10% Rh; IEC 584-1, IPTS-68).
8 . . . : T-type; copper - constantan (Cu - CuNi; IEC 584-1, IPTS-68).
9 . . . : U-type; copper - constantan (Cu - CuNi; DIN 43710).

. Q R S : The Q, R and S digits indicate the type of COLD JUNCTION COMPENSATION (see also section 4.5).

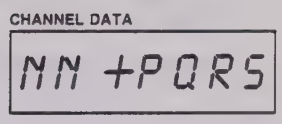
. 0 0 0 : compensation for a fixed cold-junction temperature of 0°C.
. 2 0 0 : compensation for a fixed cold-junction temperature of 20°C.
. 5 0 0 : compensation for a fixed cold-junction temperature of 50°C.
. 8 N N : The cold-junction is compensated with the temperature measured in channel NN.

The temperature in channel NN may be measured by means of a PT 100 or a thermocouple and must be between 0°C and 50°C to meet the specification.

. 9 0 0 : Internal (automatic) cold-junction compensation.

The cold-junction is the connection at the input terminals of the recorder.

5.5.1.4 ZERO AND FULL SCALE VALUE



VOLTAGE AND TEMPERATURE MEASUREMENTS (mV, V, °C)

A ZERO SCALE VALUE (ZSVDIR) and a FULL SCALE VALUE (FSVDIR) must be set.

ZSVDIR - ZERO SCALE VALUE DIRECT:
the input signal corresponding with 0% of the scale

FSVDIR - FULL SCALE VALUE DIRECT:
the input signal corresponding with 100% of the scale

Example:

a voltage from −1...+1 Volt must be measured

Select: MEASURING FUNCTION 1500 (Volt, see s. 5.5.1.3)
ZSVDIR = −1 (V)
FSVDIR = +1 (V)

The measurement result will be represented:
- in dot print mode between 0% and 100% on the chart
- in the numeric print mode from −01.00...01.00
- in the display form −01.00 ... 01.00

PROCEDURE:

- **Select the MEASURING FUNCTION (mV, V, °C)**
- **Press ZERO SCALE VALUE**
- **Press the +/− key if the sign has to be changed**
- **Press numeric keys and decimal point (if required). See "LIMITS OF ZERO AND FULL SCALE VALUES" below for minimum and maximum values.**
- **Press the ENTER key; the display goes out.**
- **Set the FULL SCALE VALUE in the same way.**

NOTE: For an even and related odd channel (e.g. 1 and 2), the ZERO SCALE VALUES are identical and the FULL SCALE VALUES are identical.

SCALED VOLTAGE MEASUREMENTS (SCALED)

Two ZERO SCALE VALUES (ZSVDIR and ZSVSCA) and two FULL SCALE VALUES (FSVDIR and FSVSCA) must be set:

ZSVDIR - ZERO SCALE VALUE DIRECT:
the input signal corresponding with 0% of the scale

ZSVSCA - ZERO SCALE VALUE SCALED:
the numeric representation when the input signal is at 0% of the scale

FSVDIR - FULL SCALE VALUE DIRECT:
the input signal corresponding with 100% of the scale

FSVSCA - FULL SCALE VALUE SCALED:
the numeric representation when the input signal is at 100% of the scale

Example:

the output voltage of a pressure transducer is 4...20 mV, corresponding to a pressure variation of 500... 1000 mbar.

Select: MEASURING FUNCTION = 1001 (SCALED mV, see s. 5.5.1.3)
ZSVDIR = 4 (mV) ZSVSCA = 500 (mbar)
FSVDIR = 20 (mV) FSVSCA = 1000 (mbar)

The measurement result will be repreented:
- in dot print mode between 0% and 100% on the chart
- in the numeric print mode form 500...1000
- in the display from 500...1000

PROCEDURE:

- **Select the MEASURING FUNCTION "SCALED" (1001, 1501)**
- **Press ZERO SCALE VALUE**
- **Press the +/– key if the sign of ZSVDIR has to be changed**
- **Press numeric keys and decimal point to select the ZSVDIR value. See "LIMITS OF ZERO AND FULL SCALE VALUES" (mV, V) below for minimum and maximum values.**
- **Press the ENTER key to store ZSVDIR: ZSVSCA will be displayed now**
- **Press the +/– key if the sign of ZSVSCA has to be changed.**
- **Press numeric keys and decimal point (–9000...9000) to select the ZSVSCA value. See "REPRESENTATION AND RESOLUTION AT SCALED MEASUREMENTS" below.**
- **Press the ENTER key to store ZSVSCA; the display goes out.**
- **Set FULL SCALE VALUES in the same way.**

NOTES:
- *For an even and related odd channel (e.g. 1 and 2), the ZERO SCALE VALUES are identical and the FULL SCALE VALUES are identical.*
- *The relation between the input voltage X and the represented value Y at SCALED measurements is determined by the expression Y = (AX + B).*
- *Scaling is only possible for voltage measurements; it relates only to the numeric representation of measurement results.*

ZERO SCALE VALUE (ZSV), UNDERSCALE (US)

The ZSV indicates the measured value to be recorded at the zero scale position on the chart in dot print mode. When the measured value is out-of-scale at the left hand side of the ZSV, the relevant channel will be recorded at the zero scale position; in the numeric print mode US (UnderScaled) will be printed as a measurement result. The display will show error code E31. The ZSV can either be positive or negative and can be higher or lower than the FULL SCALE VALUE (FSV).

FULL SCALE VALUE (FSV), OVERSCALE (OS)

The FSV indicates the measured value to be recorded at the full scale position on the chart in the dot print mode. When the measured value is out-of-scale at the right hand side of the FSV, the relevant channel will be recorded at the full scale position; in the numeric print mode OS (OverScaled) will be printed as a measurement result. The display will show error code E32. The FSV can either be positive or negative and can be higher or lower then the ZSV.

OVERLOAD (OL)

When the input value is not within the FULL and ZERO SCALE VALUE limits (see below), an overload indication (E33) is displayed. In this case no measurement result is printed in the dot mode; in the numeric mode OL (OverLoad) will be printed as a measurement result.

SPAN

The SPAN is the absolute value of the difference between the FULL and ZERO SCALE VALUE:
SPAN = |FSV - ZSV|.
The SPAN complies with the chart width.

LIMITS AND POSSIBLE COMBINATIONS OF FULL SCALE VALUE, ZERO SCALE VALUE AND SPAN.

- **Millivolt**

SPAN	FULL and ZERO SCALE VALUE limits
1 ... 30 mV	− 30 ... + 30 mV
5 ... 300 mV	− 300 ... + 300 mV
50 ... 3000 mV	−3000 ... +3000 mV

Examples:

- For a desired SPAN of 3 mV the FSV and the ZSV have to be selected within −30 and +30 mV.
- For a desired FSV of 350 mV the minimum allowed SPAN is 50 mV.

- **Volt**

SPAN	FULL and ZERO SCALE VALUE limits
0.5 ... 30 V	−30 ... +30 V

- **Thermocouples**

Type	SPAN °C	FULL and ZERO SCALE VALUE limits °C
J, L	25 ... 700	−200 ... + 500
	250 ... 850	−100 ... + 750
K	30 ... 900	−200 ... + 700
	300 ... 1470	−100 ... +1370
S	250 ... 1600	0 ... +1600
T, U	35 ... 600	−200 ... + 400

Example:

- For a required span of 50°C with a J type thermocouple, the FULL SCALE VALUE can be selected between −200°C and +500°C.
- For a FULL SCALE VALUE of +800°C, to be measured with a K type thermocouple, the minimum span is 300°C.

- **Pt 100**

SPAN °C	FULL- and ZERO SCALE VALUE limits °C
25 ... 1050	−200 ... +850

REPRESENTATION AND RESOLUTION OF SCALED MEASUREMENTS

RANGE OF THE SCALE

The scaled zero scale value (ZSVSCA) and full scale value (FSVSCA) can be set form −9000 up to 9000, with a decimal point as indicated below.

Decimal point: .X X X X
X.X X X
X X.X X
X X X.X

The decimal point for the ZSVSCA and the FSVSCA must be set to the same position. If not, the instrument will automatically set the decimal point to the highest (absolute) value of the ZSVSCA and FSVSCA.

REPRESENTATION OF THE MEASUREMENT RESULT

The measurement result on the display, the numeric printout and the output via an optional interface are represented in the same way: 4 digits and a decimal point (the "numeric representation").
The position of the decimal point in the representation is the same as in the ZSVSCA and FSVSCA.

Example: ZSVSCA = 8 0 0.0
FSVSCA = 9 0 0.0
RESULT = X X X.X

RESOLUTION

The resultion is determined by the MEASUREMENT RESOLUTION and the SCALING RESOLUTION; the lowest of the two determines the resolution.

- MEASUREMENT RESOLUTION:

$$\text{RESOLUTION} = \frac{\text{SPAN}}{\text{RANGE}} \times 60000$$

SPAN = |ZSVDIR — FSVDIR| (mV or V)

RANGE: depends on the highest absolute value of the ZSVDIR and FSVDIR, according to the table below.

MEASURING FUNCTION	highest absolute value of ZSVDIR and FSVDIR	RANGE
1001	0 ... 30 mV 30 ... 300 mV 300 ... 3000 mV	30 mV 300 mV 3000 mV
1501	0,5 ... 30 V	30 V

Example:

ZSVDIR = −1500 mV
FSVDIR = +100 mV] SPAN = 1600 mV; RANGE = 3000 mV
RESOLUTION OF THE MEASUREMENT = 32000.

In this example 32000 different values are measured between 0% and 100% of the scale.

- SCALING RESOLUTION:

  the resolution is the difference between the ZSVSCA and the FSVSCA.

  Example 1: ZSVSCA = −0001
  FSVSCA = 0001
  RESOLUTION = 2

  Example 2: ZSVSCA = 3000
  FSVSCA = 1000
  RESOLUTION = 4000

  In example 1, 3 different values can be represented (− 0001, 0000 and 0001); the scale is divided in 2 parts.
  In example 2, 4000 different values can be represented (− 1000 up to 4000); the scale is divided in 4000 parts.

- RESOLUTION:

  If the MEASUREMENT RESOLUTION is lower than the SCALING RESOLUTION, the resolution is determined by the MEASUREMENT RESOLUTION.

  Example:

  Transducer output = 2000 ... 2060 mV
  Required respresentation = −9000 ... 9000

  Select: MEASURING FUNCTION 1001 (mV, SCALED)
  ZSVDIR = 2000 FSVDIR = 2060
  ZSVSCA = −9000 FSVSCA = 9000

  MEASUREMENT RESOLUTION: $\frac{2060 - 2000}{3000} \times 60000 = 1200$

  SCALING RESOLUTION: 18000

  CONCLUSION:

  For the 18000 points on the scale only 1200 measurement results are available, the minimum step between 2 successive represented numeric values will be 15 (e.g. 0000, 0015, 0030 etc).

APPLICATION EXAMPLES

- **Recording of almost equal signals**

  Two, almost equal voltages, varying between 0 and +0,5 volt must be recorded in dot mode in channel 1 and 3. If the FULL and ZERO SCALE VALUE of both channels are set to the same value (e.g. 0 and +0,5), it will be difficult to distinguish the signals on the chart. To shift the signals on the recording, the FULL and ZERO SCALE VALUE can be set as follows:

	ZERO SCALE VALUE	FULL SCALE VALUE
CHANNEL 1	0	+1
CHANNEL 3	−0,5	+0,5

  The SPAN for both channels is 1 volt.
  CHANNEL 1 is recorded from 0 to 50 % on the chart.
  CHANNEL 3 is recorded from 50 to 100 % on the chart.

- **Millivolt measurements with current source (resistance transducers)**

  The measured voltage U is: R (Ω) x 0.7685 (mA), in which R is the transducer resistance value.

  For SPAN, FULL SCALE VALUE and ZERO SCALE VALUE see above 'Millivolt'.

  Example:

  A resistance transducer is to be measured. The resistance varies between 0 and 100 ohm.
  Select FULL SCALE VALUE 100 × 0.7685 = 76.85 mV
  Select ZERO SCALE VALUE 0 × 0.7685 = 0 mV

  The recorder indicates millivolts!
  The chart width complies with 0 - 100 ohm.

5.5.1.5 ALARM LEVELS

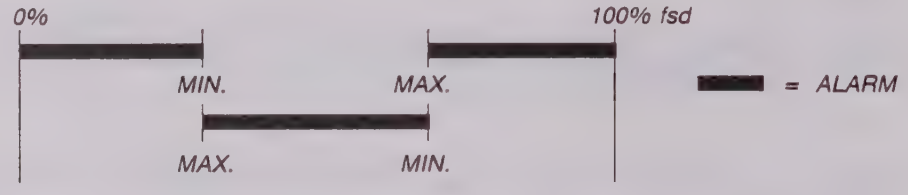
CHANNEL DATA

NN –PQRS

MIN. ALARM LEVEL ● ● MAX. ALARM LEVEL

- **Press the +/– key if the sign has to be changed.**
- **Press numeric keys and decimal point (if required).**
- **Press the ENTER key.**

NOTES: - The MIN.ALARM LEVEL may be higher or lower than the MAX. ALARM LEVEL.



- *The way in which the recorder reacts on a detected alarm can be selected, refer to RESPONSE TO ALARM, section 5.5.1.6.*
- *The alarm levels must be between the allowed FULL and ZERO SCALE VALUE; they are expressed in the same unit as the FULL and ZERO SCALE VALUE (mV, V, °C or SCALED)*
- *For an even and related odd numbered channel the alarm levels are identical.*
- *The ALARM LEVELS can be set in the SINGLE CHANNEL MEASURE mode as well in the PROGRAM mode.*
- *The ALARM LEVELS are not write protected.*

5.5.1.6 RESPONSE TO ALARM

RESP. TO ALARM ●

CHANNEL DATA

NN QRS

- **Press numeric keys to select the Q, R and S digit.**
- **Press the ENTER key.**

Specification of the Q, R and S digit

Q = 0 : No contact closure on the alarm output (at the rear) and the alarm option on alarm.
Q = 1 : Contact closure on the alarm output (at the rear) and alarm option on alarm.

R = 0 : No increase of the chart speed on alarm.
R = 1 : On alarm the chart speed increases by a factor of 10.

This applies only to the dot print mode and for selected chart speeds ≤ 60 mm/hr (or a CLOCK dividing factor ≥ 20 in case the EXTENDED CONTROL option is installed).

S = 0 : Normal recording on alarm.
S = 1 : Recording with special marking (dot mode) and <> indication (numeric print out)

On alarm the measuring result of the channel in question is recorded with a special marking in the dot print mode (not for interpolated recording, section 5.5.1.2). For special markings see section 5.5.1.2. In the numeric mode a > sign or a < sign is printed behind the measured value at a maximum - respectively minimum alarm.

NOTES: - As long as in one or more of the measured channels, in which R = 1 and/or Q = 1, an alarm level is exceeded, the chart advances with an increased speed and/or the alarm contact at the rear is closed.
- It is possible to record a channel in the dot print mode during alarm only.
Proceed as follows:
- *Set the S digit of the CHANNEL MODE to 0; the channel is not recorded (zero dots).*
- *Set the S digit in RESPONSE TO ALARM to 1; on alarm the channel is recorded with a special marking.*

- *RESPONSE TO ALARM can be individually set for odd and even numbered channels.*
- *When the measured value is out-of-span (error code E31 or E32) an alarm can still be detected.*
- *When the input value is out-of-range (error code E33) no alarm can be detected. Out-of-range means: not within the FULL and ZERO SCALE* ***limits****.*
- *An alarm can be detected during a measurement only. An alarm is detected as soon as the channel in which the alarm level is exceeded, is measured.*
  The time between the exceeding of an alarm level and the detection depends on the number of channels to be measured.

5.5.1.7 COPY CHANNEL

CHANNEL DATA

NN RS

COPY CHANNEL ⊙

All channel parameter settings of the current channel (NN) become identical to those of the keyed-in channel (RS) except for the CHANNEL MODE and RESPONSE TO ALARM.

- **Press numeric keys to select the channel to be copied (RS). The zero before the numbers below 10 needs no to be keyed-in.**
- **Press the ENTER key.**

NOTE: - *Copying the settings of a 4-terminal channel to a 2-terminal channel will result in error code E21.*
- *If a non-existing channel is tried to be copied error code E12 will be displayed. A non-existing channel is an even channel of which the related odd channel is programmed in the 4-terminal configuration.*

5.5.2 Setting the instrument parameters

5.5.2.1 TIME AND DATE

CHANNEL DATA

+PQRS

TIME DATE ⊙

- **Press the PROGRAM key to select the program mode.**
- **Press the TIME/DATE key: the TIME is displayed.**
- **If the sign must be changed: press the +/− key.**
  + : combined dot + numeric print mode.
  − : dot print mode only.
  Refer also to section 5.6.2.3.
- **If the TIME must be changed: select hours (PQ) and minutes (RS).**
- **Press the ENTER key.**
  The displayed TIME is stored now, the display shows the DATE.
- **If the DATE must be changed: select day (PQ) and month (RS).**
- **Press the ENTER key.**
  The displayed DATE is stored now, the display shows the YEAR.
- **If the YEAR must be changed, select YEAR (PQRS).**
- **Press the ENTER key.**
  The displayed YEAR is stored now, the display and TIME/DATE indication LED are blanked.

During power off the time and date are kept up.

The TIME and DATE are printed at the left side of the chart in the following situations:

- When the instrument enters the MEASURE mode (after selecting the MEASURE mode or after power on when the recorder was switched off during measuring)
- After changing the CHART DRIVE setting.
- After switching on or off the NUM.PRINT mode.
- Before a numeric print-out of the measurement results:
  TIME, in front of the first printed line
  DATE, in front of the second printed line
  At SINGLE CHANNEL MEASURE the TIME is printed in front of the line with the measuring result.
- In the DOT PRINT mode (in addition to the above mentioned situations):
  TIME and DATE - at 00h00.
  TIME - at CHART SPEEDS between 5 mm/h and 60 mm/h: each full hour.
  - at CHART SPEEDS in mm/min.: every 20 minutes including each full hour (00h00, 00h20, 00h40 etc).

5.5.2.2 CHART SPEED, PRINT INTERVAL TIME

CHANNEL DATA

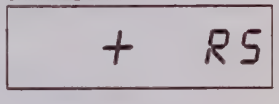


CHART DRIVE

The CHART DRIVE key can be used to set the:

- **CHART SPEED.**
- **PRINT INTERVAL TIME.**

CHART SPEED

- **Select the PROGRAM or MEASURE mode.**
- **Press the CHART DRIVE key.**
- **Select the dot print mode (NUM.PRINT 'off').**
  The display indicates the actual CHART SPEED (R and S digit).
- **Press the +/– key to change the sign**
  + = mm/min.
  – = mm/hr.
- **Press numeric keys to select the CHART SPEED (00-60).**
- **Press the ENTER key.**
  The displayed value is stored and the display and CHART DRIVE indication LED are blanked.

PRINT INTERVAL TIME

- **Select the PROGRAM or MEASURE mode.**
- **Press the CHART DRIVE key.**
- **Select the NUMERIC PRINT mode (NUM.PRINT 'on').**
  The display indicates the actual PRINT INTERVAL TIME (R and S digit) in MINUTES (numeric print mode) or HOURS (combined dot + numeric print mode).
- **Press numeric keys to select the print interval time (00-99).**
- **Press the ENTER key.**
  The displayed value is stored and the display and CHART DRIVE indication LED are blanked.

CHART SPEED

In the DOT PRINT mode and combined DOT + NUMERIC PRINT mode (NUM. PRINT "off"), the chart advances at the selected speed.

PRINT INTERVAL TIME

Each time the print interval time is up, the measurement results are recorded in numerals. This applies to:

- The NUMERIC PRINT mode: NUM.PRINT 'on'.
  The print interval time is 0..99 MINUTES.
- The combined DOT + NUMERIC PRINT mode: NUM.PRINT 'off'; sign of TIME is +
  The print interval time is 0..99 HOURS: if set to 0 (zero), the print interval time is 10 minutes.

NOTE: If the EXTENDED CONTROL option is installed, the CHART DRIVE key can be used to set a dividing factor for externally supplied chart feed clock pulses. Refer to the manual 'PM8238 INTERFACES TO OTHER DEVICES'.

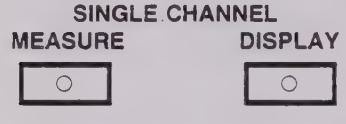
5.6 MEASURING, DISPLAYING, RECORDING

In the MEASURE mode (MEASURE 'on') the input signals of the selected channels are measured, displayed and recorded.

5.6.1 Measuring and displaying

MEASURING and DISPLAYING can be done in one of the following ways:
- measuring and displaying all selected channels.
- measuring and displaying one channel.
- measuring all selected channels and displaying one channel.

5.6.1.1 MEASURING AND DISPLAYING ALL CHANNELS

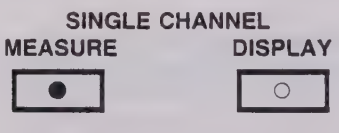


- **Switch off the SINGLE CHANNEL MEASURE and SINGLE CHANNEL DISPLAY indication.**

  All channels not skipped and correctly programmed are continuously (sequentially) measured and displayed.

  Each 3,5 second the measuring result of the next (measured) channel is displayed.

5.6.1.2 MEASURING AND DISPLAYING ONE CHANNEL



- **Switch on SINGLE CHANNEL MEASURE; SINGLE CHANNEL DISPLAY will be automatically switched off.**

  The indicated channel is continuously measured.

To select the channel to be measured:

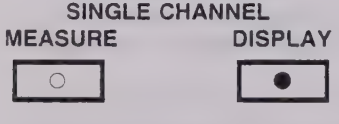
- **press the MEASURE mode selection key to select the NEXT CHANNEL**

  OR

- **key-in a channel number and press ENTER to select an ARBITRARY CHANNEL.**

  NOTE: A channel cannot be selected if it does not exist, if it is not correctly programmed or if it is skipped. In these cases error code E12 will be displayed for approx. 1 second.

5.6.1.3 MEASURING ALL CHANNELS, DISPLAYING ONE CHANNEL



- **Switch off SINGLE CHANNEL MEASURE, switch on SINGLE CHANNEL DISPLAY.**

  All selected channels are measured; only the measuring result of the indicated channel is displayed.

To select the channel to be displayed:

- **press the MEASURE mode selection key to select the NEXT (measured) CHANNEL.**

  OR

- **key-in a channel number and press ENTER to select an ARBITRARY CHANNEL.**

  NOTE: A channel cannot be selected if it does not exist, if it is not correctly programmed or if it is skipped. In these cases error code E12 will be displayed for approx. 1 second.

5.6.2 Recording

The measurement results can be recorded:

- as dotted lines (DOT PRINT mode).
- in numeric tables (NUM.PRINT mode).
- as a combination of dotted lines and numeric tables (DOT + NUM.PRINT mode).

5.6.2.1 DOT PRINT MODE

- **Select the PROGRAM mode.**
- **Set the sign of TIME at — (see section 5.5.2.1).**
- **Switch NUM PRINT off**
- **Set CHART SPEED (see section 5.5.2.2).**
- **Select the MEASURE mode.**

In the dot print mode the measurement results are recorded as dotted lines.
A measured value is represented by a single dot or a special marking; interpolation dots can be printed between two printed measurement results of the same channel (refer to section 5.5.1.2 'Channel mode'). On alarm a special marking can be printed (refer to section 5.5.1.6 'Response to alarm').
There are 1001 possible print positions at distances of 0.25 mm.

At overscale or underscale of the measurement result the dots are printed at 100% or 0% of the scale respectively.
A channel is not recorded when its input signal is not between the limits of the zero and full scale value (see section 5.5.1.4); in this case E33 (overload) is displayed.
The measurement results of all measured channels are printed within one print-scan if the following conditions are fulfilled:

- All channels are measured at least once after the previous print-scan.
- the chart is advanced at least 0.4 mm after the previous print-scan.

NOTE: At high chart speeds the distance between the print-scans will become more than 0.4 mm.

Chart speed

To obtain a recorded plot with smooth lines the following rule can be applied to determine the appropriate chart speed:

$$\text{CHART SPEED} \leq \frac{0{,}4 \times 60}{(n \times Tm) + Tp} \quad \text{mm/min}$$

n is the number of measured channels
Tm is the measuring time per channel in seconds (= 0.1 s)
Tp is the time needed for a print-scan, an average value of 3 seconds

Example:

All 30 channels measured

$$\text{CHART SPEED} \leq \frac{0{,}4 \times 60}{30 \times 0{,}1 + 3} = 4 \text{ mm/min}$$

If the chart speed is higher, the distance between two successive dots for one channel will become more than 0,4 mm.

Printing of the channel numbers

The channel numbers are printed next to the recording of each channel. Fig. 19 shows the channel numbers if channels 1-7 are measured.

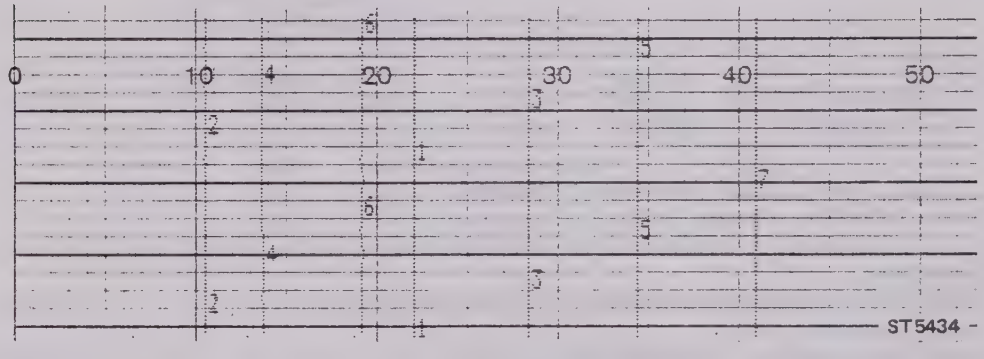


Fig. 19. Printing of the channel numbers

Printing of the time and date

TIME and DATE are printed at the left side of the chart in the following situations:

- DATE at 00h00
- TIME
  - for CHART SPEEDS in mm/min: every 20 minutes including each full hour (12h00, 12h20, 12h40, 13h00 etc).
  - for CHART SPEEDS between 5 mm/h and 60 mm/h: each full hour.
  - for CHART SPEEDS under 5 mm/h: at 00h00

5.6.2.2 NUMERIC PRINT MODE

NUM PRINT

- **Switch NUM PRINT on**
- **Set the print interval time (in minutes, see section 5.5.2.2).**
- **Select the MEASURE mode.**

In the numeric print mode the measurement results of all measured channels are periodically printed within one print-scan. During a print-scan three lines (or one line at SINGLE CHANNEL MEASURE) are printed as shown below. The time between two successive print-scans is the print interval time (refer to section 5.5.2.2).

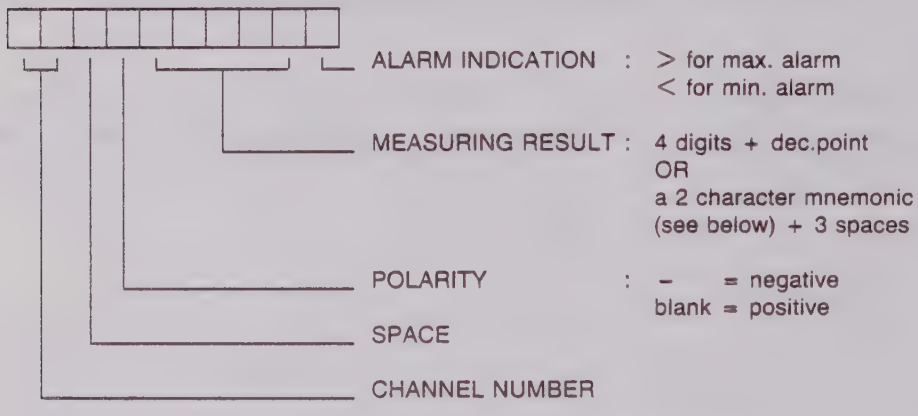
	CH.21	CH.22	CH.23	CH.24	CH.25	CH.26	CH.27	CH.28	CH.29	CH.30
TIME	CH.11	CH.12	CH.13	CH.14	CH.15	CH.16	CH.17	CH.18	CH.19	CH.20
DATE	CH.01	CH.02	CH.03	CH.04	CH.05	CH.06	CH.07	CH.08	CH.09	CH.10

TIME and DATE

The DATE is printed before the measurement results is the first printed line, the DATE before the second printed line. At SINGLE CHANNEL MEASURE only the TIME is printed.

Format of the measuring results

Each measurement result takes up 10 character positions, viz:



If a channel is not measured its measurement result location on the chart will be left blank. The reason can be one of the following:
- the channel is not correctly programmed.
- the channel is skipped.
- the channel does not exist: an even numbered channel does not exist if the associated odd numbered channel is programmed in the 4-terminal input configuration.

A two-character mnemonic will be printed in case an erroneous condition is detected:

OS	OVERSCALE	: the input value is overscaled (see section 5.5.1.4).
US	UNDERSCALE	: the input value is underscaled (see section 5.5.1.4).
OL	OVERLOAD	: the input value is not within the FULL and ZERO SCALE VALUE limits (see section 5.5.1.4).
OC	OPEN CIRCUIT	: thermocouple break (refer to section 5.3).
CJ	COLD JUNCTION	: cold junction compensation error. The cold junction is compensated with a temperature measured in another channel; this measurement does not give a correct result (e.g. overscale).
IB	INPUT BLOCK	: the internal (automatic) cold junction compensation does not function correctly (see section 4.5).
DM	DIFFERENTIAL MEASUREMENT	: erroneous result of a differential measurement. See also section 6 'E37'.

5.6.2.3 Combined DOT + NUMERIC PRINT mode

- **Select the PROGRAM mode.**
- **Set the sign of TIME at + (see section 5.5.2.1).**
- **Switch NUM PRINT on.**
- **Set the print interval time (hours, 00 = 10 minutes, see section 5.5.2.2).**
- **Switch NUM PRINT off.**
- **Set the CHART SPEED (see section 5.5.2.2).**
- **Select the MEASURE mode.**

The measurement results are recorded as dotted lines, the chart moves at a constant speed. In addition, a numeric print out is given every time the print interval time (expressed in hours) is up.
The minimum print interval time is 10 minutes (if the print interval time is set to 00).

As the chart advances at a constant speed, a numeric print-out will be slanting with respect to the time axis, specially at high chart speeds.

5.7 PRINTING THE CHANNEL SETTINGS

PRINT PROGRAM

- **Press the PRINT PROGRAM key.**
  All channel settings are listed on the chart.

  NOTE: Press STANDBY to interrupt the printing.

A memonic is printed before every line, to indicate the contents of the line.

MODODD : The numbers of the odd channels and the set CHANNEL MODE. Additional information is given by means of the following abbreviations:

SK - the channel is skipped.
PE - program error, the channel is not correctly programmed.

MODEVN : The numbers of the even channels and the set CHANNEL MODE. Additional information is given by means of the following abbreviations:

SK - the channel is skipped.
PE - program error, the channel is not correctly programmed.
NE - the channel does not exist because the associated odd channel is in the 4-terminal input mode.

MEASFN : The set MEASURING FUNCTION for an odd and associated even numbered channel.

ZSVDIR : The set ZERO SCALE VALUE for an odd and associated even numbered channel.

ZSVSCA : The set scale value, expressed in the transducer unit, corresponding to the ZERO SCALE VALUE. For SCALED MEASUREMENTS only.

FSVDIR : The set FULL SCALE VALUE for an odd and associated even numbered channel.

FSVSCA : The set scale value, expressed in the transducer unit, corresponding to the FULL SCALE VALUE. For SCALED MEASUREMENTS only.

MINALM : The set MINIMUM ALARM LEVEL for an odd and associated even numbered channel.

MAXALM : The set MAXIMUM ALARM LEVEL for an odd and associated even numbered channel.

RESODD : The RESPONSE TO ALARM setting preceeded by the odd channel numbers.

RESEVN : The RESPONSE TO ALARM setting preceeded by the even channel numbers.

NOTE: - sign, negative polarity
no sign, positive polarity (if applicable)

CHANNEL PARAMETERS	CHANNEL NUMBERS					
MODODD	01 401SK	03 411	05 411	07 212	09 213	11 211
MODEVN	02 200NE	04 200NE	06 201NE	08 211	10 211	12 212
MEASFN	2000	2000	2000	1001	−6900	1500
ZSVDIR	−0100.	−0100.	−0100.	0004.	−0000.	0020.
ZSVSCA				0900		
FSVDIR	0100.	−0010.	0250.	0020.	0300.	0022.
FSVSCA				1100		
MINALM	−0050.	0050.	−0010.	0000.	0100.	020.5
MAXALM	0050.	0000.	0010.	0010.	0200.	021.5
RESODD	01 111	03 001	05 110	07 000	09 111	11 111
RESEVN	02 001	04 000	06 111	08 010	10 100	12 000

5.8 PRINTING ADDITIONAL NUMERIC TEXT

In the STANDBY mode it is possible to print additional numeric text.

Proceed as follows:

- **Press the STANDBY key if its LED indication is off.**
- **Press:**
  - Numeric keys to print numerals 0...9.
  - CLEAR key to create a space.
  - ENTER key for a carriage return + line feed.
  - ·key to print a dot.
  - +/− key to print an oblique stroke (/).

5.9 SELECTING A CHANNEL

5.9.1 Selecting a channel to be programmed

The display will show a channel number. This channel can be programmed. If another channel has to be programmed it can be selected in one of the following ways:

The required channel number is the next in succession:

- **Press the PROGRAM key.**
  The next channel number will now be displayed. If a channel parameter was selected it is still selected in this channel.

The required channel number is an arbitrary one

- **Press the CLEAR key if the DATA part of the display shows a parameter.**
- **Press the ENTER key if a channel or instrument parameter LED indication is on.**
- **Key-in the channel number.**
  The DATA part of the display shows the result.
- **Press the ENTER key.**
  The DATA part of the display is cleared and the CHANNEL part shows the selected channel number.

NOTE: When an odd numbered channel n is programmed as a 4-input terminal one, the even numbered channel n + 1 does not exist. Trying to select a non-existing channel results in error code E11 or E12.

5.9.2 Selecting a channel to be measured and displayed

Selecting another channel is useful only for SINGLE CHANNEL DISPLAY or SINGLE CHANNEL MEASURE: only the selected channel will be displayed or measured respectively.
There are two ways to select another channel:

The required channel is the next in succession

- **Press the MEASURE key.**

The required channel is an arbitrary one

- **Press numeric keys appropriate to the required channel number.**
  The measurement result is replaced with the channel number.
- **Press the ENTER key.**

NOTE: A channel cannot be selected if:

- *it does not exist*
- *it is not correctly programmed*
- *it is skipped*

In these cases error code E12 will be displayed. This error code will be replaced within one second with the measurement result of the current channel.

6. ERROR MESSAGES

GENERAL INSTRUMENT ERRORS

E01 - PROGRAM MODULE FAILURE

The CHART DRIVE parameters are set to the default values:
+01 (SPEED), 00 (PRINT INTERVAL TIME), 2 (DIVIDING FACTOR, see EXT.CONTROL INTERFACE).

- check the PROGRAM MODULE battery (section 3.3) or replace the PROGRAM MODULE.

E02 - ALL CHANNELS ARE SKIPPED OR NONE OF THE CHANNELS TO BE MEASURED IS PROPERLY PROGRAMMED

- check the channel parameter settings (section 5.5.1).

E03 - PAPER OUT INDICATION

- load new paper (section 3.1.4).

E04 - PROGRAM MODULE NOT PRESENT

- insert a PROGRAM MODULE.

E05 - ONE OF THE CALIBRATION SETTING STORES IS WRONG

The calibration settings are stored 3 times (in separate stores). If one of these stores is not correct, the other two ensure the correct operation of the instrument.

- inform your local Philips organisation when the instrument requires servicing for any other reason.

OPERATING ERRORS

E11 - THE REQUIRED CHANNEL NUMBER CANNOT BE SELECTED AS IS NOT IN THE RANGE 1...30

The current channel number is maintained. During measuring the error code can be replaced by a measurement result within a short time.

- select a correct channel number.

E12 - THE REQUIRED CHANNEL CANNOT BE SELECTED BECAUSE:

- the channel does not exist because the belonging odd channel is programmed as a 4-terminal channel (CHANNEL MODE 4 .., section 5.5.1.2).
- the channel is skipped (CHANNEL MODE .0., section 5.5.1.2).
- the channel contains invalid program data.

- check the channel parameter settings (section 5.5.1).

E13 - THE CURRENT CHANNEL CANNOT BE MEASURED AND DISPLAYED BECAUSE IT CONTAINS INVALID PROGRAM DATA

Selecting the MEASURE mode when SINGLE CHANNEL MEASURE or SINGLE CHANNEL DISPLAY are on and the current channel is not properly programmed results in E13.
The previous mode (PROGRAM or STANDBY) is maintained.

- check the channel parameters of the current channel (section 5.5.1).

NOTE: Measuring all channels is possible (SINGLE CHANNEL MEASURE or DISPLAY off); the erroneous channel is not measured then.

E14 - THE PROGRAM MODULE IS WRITE PROTECTED (see section 5.2.2).

PROGRAMMING ERRORS

E20 - MEASURING FUNCTION 3... IS PROGRAMMED (thermocouple linearisation option); THE OPTION IS NOT INSTALLED.

E21 - COPY CHANNEL ERROR

The settings of a 4-terminal channel (channel mode 4..) cannot be copied into a 2-terminal channel (channel mode 2..) for e.g. PT 100 measurements.

- check if the CHANNEL MODE is not in conflict with the MEASURING FUNCTION (e.g. 2-terminal channel is contrary to PT100 measuring function). See section 5.5.1.2 and 5.5.1.3.

E22 - THE KEYED-IN CODE IS INVALID

e.g. CHANNEL MODE 999 is invalid.

- concerns CHANNEL MODE, MEASURING FUNCTION and RESPONSE TO ALARM.

E23 - THE KEYED-IN VALUE IS INVALID

e.g. TIME is set to 3300

- concerns TIME, CHART DRIVE, FULL and ZERO SCALE VALUE, MAX. and MIN. ALARM LEVEL.

E24 - THE PROGRAMMED FULL AND ZERO SCALE VALUE ARE CONTRARY TO THE MEASURING FUNCTION

example: The selected measuring function is mV (1000)
FSV is +100 mV
ZSV is −100 mV
The measuring function is changed now to V (1500)
FSV and ZSV are implemented now as +100 and −100V, which is out the max. range −30 V ... +30 V.

- THE PROGRAMMED MEASURING FUNCTION IS CONTRARY TO THE CHANNEL MODE

example: The selected input configuration is 4-terminal.
The measuring function is PT 100 (2000). When the CHANNEL MODE is changed in such a way that the input configuration becomes 2-terminal, a conflicting situation will occur.

E25 - NESTING IN A DIFFERENTIAL MEASUREMENT (refer to section 5.5.1.3)

In the PROGRAM mode and STANDBY mode this error code is displayed in each channel until the erroneous situation is removed.
In the MEASURE mode the erroneous channels are not measured. When a channel parameter is selected the display will flicker once because the error code is displayed a very short time before the parameter selection.

- check MEASURING FUNCTIONS (00NN is differential measurement).

MEASUREMENT ERRORS

E30 - GENERAL MEASUREMENT RESULT ERROR

E31 - MEASUREMENT RESULT UNDERSCALED

the measurement result is below the ZERO SCALE VALUE.

E32 - MEASUREMENT RESULT OVERSCALED

the measurement result is above the FULL SCALE VALUE.

NOTE: At E31 and E32 the recorder prints
- *in the NUMERAL PRINT mode 'US' and 'OS' respectively.*
- *in the DOT PRINT mode at the left margin and right margin respectively.*

E33 - THE INPUT SIGNAL IS OUT OF RANGE

The signal is not between the limits of the FULL and ZERO SCALE VALUE (section 5.5.1.4).

NOTE: At E33 the recorder prints
- *in the NUMERIC PRINT mode 'OL'.*
- *in the DOT PRINT mode no measurement result.*

E34 - THERMOCOUPLE BREAK DETECTED

An open input is detected during a thermocouple measurement.

NOTE: At E34 the recorder prints
- *in the NUMERIC PRINT mode 'OC'.*
- *in the DOT PRINT mode no measurement result.*

E35 - ERROR IN THE MEASUREMENT OF THE INPUT-BLOCK TEMPERATURE

The instrument is defective

- contact your local Philips organisation.

E36 - EXTERNALLY MEASURED COLD JUNCTION COMPENSATION ERROR

In the current channel a thermocouple measurement is done; the cold junction compensation is done via a measurement of the cold junction in another channel, e.g. channel NN.
The measurement in channel NN is erroneous; as a consequence the cold junction temperature of the current channel cannot be compensated for.

- check channel NN..

E37 - DIFFERENTIAL MEASUREMENT ERROR

One of the channels involved in the differential measurement gives no measuring result.

- check the channels involved.

NOTE: After switching-on or after selecting the MEASURE mode, the channel to which the difference has to be determined, must have been measured. If not, E37 will be displayed.

E38 - THE RECORDER DOES NOT MEET THE SPECIFICATIONS

The calibration settings are not correct. The instrument functions, but does not meet the specifications as listed in section 2.2.

- contact your local Philips organisation.